Part No. 02103SL (Rev. A)

Service Manual

Reelmaster® 2000-D

Preface

The purpose of this publication is to provide the service technician with information for troubleshooting, testing, and repair of major systems and components on the Reelmaster 2000-D.

REFER TO THE TRACTION UNIT AND CUTTING UNIT OPERATOR'S MANUALS FOR OPERATING, MAINTENANCE, AND ADJUSTMENT INSTRUCTIONS. Space is provided in Chapter 2 of this book to insert the Operator's Manuals and Parts Catalogs for your machine. Additional copies of the Operator's Manual and Parts Catalog are available on the internet at www.Toro.com.

The Toro Company reserves the right to change product specifications or this publication without notice.

This safety symbol means DANGER, WARNING, or CAUTION, PERSONAL SAFETY INSTRUCTION. When you see this symbol, carefully read the instructions that follow. Failure to obey the instructions may result in personal injury.

NOTE: A **NOTE** will give general information about the correct operation, maintenance, service, testing, or repair of the machine.

IMPORTANT: The IMPORTANT notice will give important instructions which must be followed to prevent damage to systems or components on the machine.

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Chapter 1

Safety

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Safety Instructions

The Reelmaster 2000−D has been tested and certified by TORO for compliance with existing safety standards and specifications as specified in the Traction Unit Operator's Manual. Although hazard control and accident prevention partially are dependent upon the design and configuration of the machine, these factors are also dependent upon the awareness, concern, and proper training of the personnel involved in the operation, transport, maintenance, and storage of the machine. Improper use or maintenance of the machine can result in injury or death. To reduce the potential for injury or death, comply with the following safety instructions.

WARNING

To reduce the potential for injury or death, comply with the following safety instructions.

Before Operating

1. Read and understand the contents of the Operator's Manual before starting and operating the machine. Become familiar with the controls and know how to stop the machine and engine quickly. Additional copies of the Operator's Manual are available on the internet at www.Toro.com.

2. Keep all shields, safety devices, and decals in place. If a shield, safety device, or decal is defective, illegible or damaged, repair or replace it before operating the machine. Also tighten any loose nuts, bolts or screws to ensure machine is in safe operating condition.

3. Assure interlock switches are adjusted correctly so engine cannot be started unless traction pedal is in NEUTRAL and cutting units are DISENGAGED.

4. Since diesel fuel is highly flammable, handle it carefully:

   A. Store fuel in containers specifically designed for this purpose.

   B. Do not remove machine fuel tank cap while engine is hot or running.

   C. Do not smoke while handling fuel.

   D. Fill fuel tank outdoors and only to within an inch of the top of the tank, not the filler neck. Do not overfill.

   E. Wipe up any spilled fuel.

While Operating

1. Sit on the seat when starting and operating the machine.

2. Before starting the engine:

   A. Engage the parking brake.

   B. Make sure traction pedal is in neutral and the PTO switch is OFF (disengaged).

   C. After engine is started, release parking brake and keep foot off traction pedal. Machine must not move. If movement is evident, the traction pedal linkage is adjusted incorrectly; therefore, shut engine off and adjust traction pedal linkage until machine does not move when traction pedal is released.

3. Do not run engine in a confined area without adequate ventilation. Exhaust fumes are hazardous and could possibly be deadly.

4. Do not touch engine, muffler or exhaust pipe while engine is running or soon after it is stopped. These areas could be hot enough to cause burns.

5. Before getting off the seat:

   A. Ensure that traction pedal is in neutral.

   B. Set parking brake.

   C. Disengage cutting units and wait for blades to stop.

   D. Stop engine and remove key from ignition switch.

   E. Anytime the machine is parked (short or long term), the cutting units should be lowered to the ground. This relieves pressure from the lift circuit and eliminates the risk of cutting units accidentally lowering to the ground.

   F. Do not park on slopes unless wheels are chocked or blocked.

D. Stop engine and remove key from ignition switch.

E. Anytime the machine is parked (short or long term), the cutting units should be lowered to the ground. This relieves pressure from the lift circuit and eliminates the risk of cutting units accidentally lowering to the ground.

F. Do not park on slopes unless wheels are chocked or blocked.

Maintenance and Service

1. Before servicing or making adjustments, lower decks, stop engine, set parking brake, and remove key from the switch.

2. Make sure machine is in safe operating condition by keeping all nuts, bolts and screws tight.

3. Never store the machine or fuel container inside where there is an open flame, such as near a water heater or furnace.

4. Make sure all hydraulic line connectors are tight, and all hydraulic hoses and lines are in good condition before applying pressure to the system.

5. Keep body and hands away from pin hole leaks in hydraulic lines that eject high pressure hydraulic fluid. Use cardboard or paper to find hydraulic leaks. Hydraulic fluid escaping under pressure can penetrate skin and cause injury. Fluid accidentally injected into the skin must be surgically removed within a few hours by a doctor familiar with this form of injury or gangrene may result.

6. Before disconnecting or performing any work on the hydraulic system, all pressure in system must be relieved by stopping engine and lowering cutting units to the ground.

7. If major repairs are ever needed or assistance is desired, contact an Authorized Toro Distributor.

8. Use care when checking the cutting reels. Wear gloves and use caution when servicing them.

9. To reduce potential fire hazard, keep engine area free of excessive grease, grass, leaves and dirt. Clean protective screen on machine frequently.

10. If engine must be running to perform maintenance or an adjustment, keep hands, feet, clothing, and other parts of the body away from cutting units and other moving parts. Keep bystanders away.

11. Do not overspeed the engine by changing governor setting. To assure safety and accuracy, check maximum engine speed.

12. Shut engine off before checking or adding oil to the crankcase.

13. Disconnect battery before servicing the machine. Disconnect negative battery cable first and positive cable last. If battery voltage is required for troubleshooting or test procedures, temporarily connect the battery. Reconnect positive cable first and negative cable last.

14. Battery acid is poisonous and can cause burns. Avoid contact with skin, eyes, and clothing. Protect your face, eyes, and clothing when working with a battery.

15. Battery gases can explode. Keep cigarettes, sparks, and flames away from the battery.

16. At the time of manufacture, the machine conformed to the safety standards for riding mowers. To assure optimum performance and continued safety certification of the machine, use genuine Toro replacement parts and accessories. Replacement parts and accessories made by other manufacturers may result in non-conformance with the safety standards, and the warranty may be voided.

17. When changing attachments, tires, or performing other service, use correct blocks, hoists, and jacks. Make sure machine is parked on a solid level floor such as a concrete floor. Prior to raising the machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use jack stands or solid wood blocks to support the raised machine. If the machine is not properly supported by blocks or jack stands, the machine may move or fall, which may result in personal injury (see Jacking Instructions).

Jacking Instructions

CAUTION

When changing attachments, tires, or performing other service, use correct blocks, hoists, and jacks. Make sure machine is parked on a solid level surface such as a concrete floor. Prior to raising machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use jack stands or solid wood blocks to support the raised machine. If the machine is not properly supported by blocks or jack stands, the machine may move or fall, which may result in personal injury.

Jacking the Front End

1. Set parking brake and chock rear tire to prevent the machine from moving.

2. Position jack securely under the frame, just to the inside of the front tire.

3. Jack front of machine off the ground.

4. Position jack stands or hardwood blocks under the frame as close to the wheel as possible to support the machine.

Jacking the Rear End

1. Set parking brake and chock both front tires to prevent the machine from moving.

2. Place jack securely under the frame directly in front of the castor fork/rear wheel.

3. Jack rear of machine off the ground.

4. Position jack stands or hardwood blocks under the frame to support the machine.

Safety and Instruction Decals

Numerous safety and instruction decals are affixed to the traction unit and the cutting units of the Reelmaster 2000–D. If any decal becomes illegible or damaged, install a new decal. Part numbers are listed in your Parts Catalog. Order replacement decals from your Authorized Toro Distributor.

Product Records and Maintenance

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Product Records

Insert Operator's Manual and Parts Catalog for your Reelmaster at the end of this chapter. Refer to Operator's Manual for recommended maintenance intervals. Additionally, insert Installation Instructions, Operator's Manuals and Parts Catalogs for any accessories that have been installed on your Reelmaster at the end of this section.

Maintenance

Maintenance procedures and recommended service intervals for your Reelmaster are covered in the Operator's Manual. Refer to that publication when performing regular equipment maintenance. Several maintenance procedures have break–in intervals identified in the Operator's Manual. Refer to the Engine Operator's Manual for additional engine specific maintenance procedures.

Equivalents and Conversions

Decimal and Millimeter Equivalents

Fractions	Decimals	mm	Fractions	Decimals	mm
1/64	0.015625	— 0.397	33/64	0.515625	— 13.097
1/32	0.03125	— 0.794	17/32	0.53125	— 13.494
3/64	0.046875	— 1.191	35/64	0.546875	— 13.891
1/16	0.0625	— 1.588	9/16	0.5625	— 14.288
5/64	0.078125	— 1.984	37/64	0.578125	— 14.684
3/32	0.09375	— 2.381	19/32	0.59375	— 15.081
7/64	0.109275	— 2.778	39/64	0.609375	— 15.478
1/8	0.1250	— 3.175	**5/8**	0.6250	— 15.875
9/64	0.140625	— 3.572	41/64	0.640625	— 16.272
5/32	0.15625	— 3.969	21/32	0.65625	— 16.669
11/64	0.171875	— 4.366	43/64	0.671875	— 17.066
3/16	0.1875	— 4.762	11/16	0.6875	— 17.462
13/64	0.203125	— 5.159	45/64	0.703125	— 17.859
7/32	0.21875	— 5.556	23/32	0.71875	— 18.256
15/64	0.234375	— 5.953	47/64	0.734375	— 18.653
1/4	0.2500	— 6.350	**3/4**	0.7500	— 19.050
17/64	0.265625	— 6.747	49/64	0.765625	— 19.447
9/32	0.28125	— 7.144	25/32	0.78125	— 19.844
19/64	0.296875	— 7.541	51/64	0.796875	— 20.241
5/16	0.3125	— 7.938	13/16	0.8125	— 20.638
21/64	0.328125	— 8.334	53/64	0.828125	— 21.034
11/32	0.34375	— 8.731	27/32	0.84375	— 21.431
23/64	0.359375	— 9.128	55/64	0.859375	— 21.828
3/8	0.3750	— 9.525	**7/8**	0.8750	— 22.225
25/64	0.390625	— 9.922	57/64	0.890625	— 22.622
13/32	0.40625	— 10.319	29/32	0.90625	— 23.019
27/64	0.421875	— 10.716	59/64	0.921875	— 23.416
7/16	0.4375	— 11.112	15/16	0.9375	— 23.812
29/64	0.453125	— 11.509	61/64	0.953125	— 24.209
15/32	0.46875	— 11.906	31/32	0.96875	— 24.606
31/64	0.484375	— 12.303	63/64	0.984375	— 25.003
1/2	0.5000	— 12.700	**1**	1.000	— 25.400
1 mm = 0.03937 in.			**0.001 in. = 0.0254 mm**		

U.S.to Metric Conversions

	To Convert	Into	Multiply By
Linear Measurement	Miles	Kilometers	1.609
	Yards	Meters	0.9144
	Feet	Meters	0.3048
	Feet	Centimeters	30.48
	Inches	Meters	0.0254
	Inches	Centimeters	2.54
	Inches	Millimeters	25.4
Area	Square Miles	Square Kilometers	2.59
	Square Feet	Square Meters	0.0929
	Square Inches	Square Centimeters	6.452
	Acre	Hectare	0.4047
Volume	Cubic Yards	Cubic Meters	0.7646
	Cubic Feet	Cubic Meters	0.02832
	Cubic Inches	Cubic Centimeters	16.39
Weight	Tons (Short)	Metric Tons	0.9078
	Pounds	Kilograms	0.4536
	Ounces (Avdp.)	Grams	28.3495
Pressure	Pounds/Sq. In.	Kilopascal	6.895
	Pounds/Sq. In.	Bar	0.069
Work	Foot-pounds	Newton-Meters	1.356
	Foot-pounds	Kilogram-Meters	0.1383
	Inch-pounds	Kilogram-Centimeters	1.152144
Liquid Volume	Quarts	Liters	0.9463
	Gallons	Liters	3.785
Liquid Flow	Gallons/Minute	Liters/Minute	3.785
Temperature	Fahrenheit	Celsius	1. Subract 32° 2. Multiply by 5/9

Torque Specifications

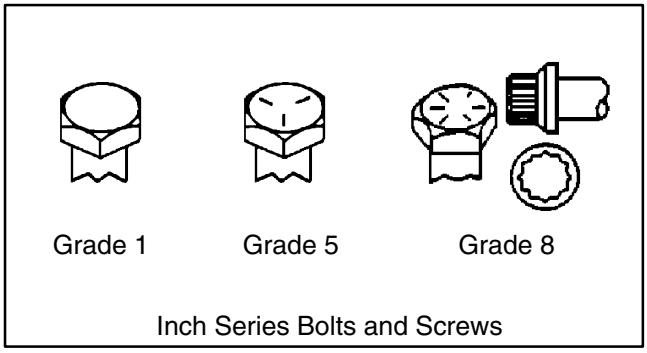
Recommended fastener torque values are listed in the following tables. For critical applications, as determined by Toro, either the recommended torque or a torque that is unique to the application is clearly identified and specified in this Service Manual.

These Torque Specifications for the installation and tightening of fasteners shall apply to all fasteners which do not have a specific requirement identified in this Service Manual. The following factors shall be considered when applying torque: cleanliness of the fastener, use of a thread sealant (e.g. Loctite), degree of lubrication on the fastener, presence of a prevailing torque feature, hardness of the surface underneath the fastener's head, or similar condition which affects the installation.

As noted in the following tables, torque values should be **reduced by 25% for lubricated fasteners** to achieve the similar stress as a dry fastener. Torque values may also have to be reduced when the fastener is threaded into aluminum or brass. The specific torque value should be determined based on the aluminum or brass material strength, fastener size, length of thread engagement, etc.

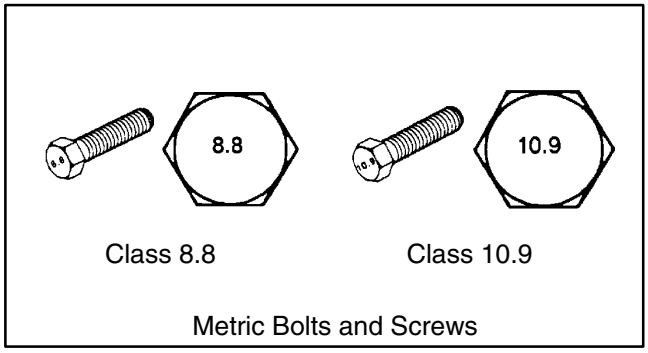
The standard method of verifying torque shall be performed by marking a line on the fastener (head or nut) and mating part, then back off fastener 1/4 of a turn. Measure the torque required to tighten the fastener until the lines match up.

Fastener Identification



Inch Series Bolts and Screws

Figure 1



Metric Bolts and Screws

Figure 2

Standard Torque for Dry, Zinc Plated, and Steel Fasteners (Inch Series)

Thread Size	Grade 1, 5, & 8 with Thin Height Nuts	SAE Grade 1 Bolts, Screws, Studs, & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 5 Bolts, Screws, Studs, & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 8 Bolts, Screws, Studs, & Sems with Regular Height Nuts (SAE J995 Grade 5 or Stronger Nuts)	
	in–lb	**in–lb**	**N–cm**	**in–lb**	**N–cm**	**in–lb**	**N–cm**
# 6 – 32 UNC	10 ± 2	13 ± 2	147 ± 23	15 ± 2	170 ± 20	23 ± 2	260 ± 20
# 6 – 40 UNF				17 ± 2	190 ± 20	25 ± 2	280 ± 20
# 8 – 32 UNC	13 ± 2	25 ± 5	282 ± 30	29 ± 3	330 ± 30	41 ± 4	460 ± 45
# 8 – 36 UNF				31 ± 3	350 ± 30	43 ± 4	485 ± 45
# 10 – 24 UNC	18 ± 2	30 ± 5	339 ± 56	42 ± 4	475 ± 45	60 ± 6	675 ± 70
# 10 – 32 UNF				48 ± 4	540 ± 45	68 ± 6	765 ± 70
1/4 – 20 UNC	48 ± 7	53 ± 7	599 ± 79	100 ± 10	1125 ± 100	140 ± 15	1580 ± 170
1/4 – 28 UNF	53 ± 7	65 ± 10	734 ± 113	115 ± 10	1300 ± 100	160 ± 15	1800 ± 170
5/16 – 18 UNC	115 ± 15	105 ± 17	1186 ± 169	200 ± 25	2250 ± 280	300 ± 30	3390 ± 340
5/16 – 24 UNF	138 ± 17	128 ± 17	1446 ± 192	225 ± 25	2540 ± 280	325 ± 30	3670 ± 340
	ft–lb	**ft–lb**	**N–m**	**ft–lb**	**N–m**	**ft–lb**	**N–m**
3/8 – 16 UNC	16 ± 2	16 ± 2	22 ± 3	30 ± 3	41 ± 4	43 ± 4	58 ± 5
3/8 – 24 UNF	17 ± 2	18 ± 2	24 ± 3	35 ± 3	47 ± 4	50 ± 4	68 ± 5
7/16 – 14 UNC	27 ± 3	27 ± 3	37 ± 4	50 ± 5	68 ± 7	70 ± 7	95 ± 9
7/16 – 20 UNF	29 ± 3	29 ± 3	39 ± 4	55 ± 5	75 ± 7	77 ± 7	104 ± 9
1/2 – 13 UNC	30 ± 3	48 ± 7	65 ± 9	75 ± 8	102 ± 11	105 ± 10	142 ± 14
1/2 – 20 UNF	32 ± 3	53 ± 7	72 ± 9	85 ± 8	115 ± 11	120 ± 10	163 ± 14
5/8 – 11 UNC	65 ± 10	88 ± 12	119 ± 16	150 ± 15	203 ± 20	210 ± 20	285 ± 27
5/8 – 18 UNF	75 ± 10	95 ± 15	129 ± 20	170 ± 15	230 ± 20	240 ± 20	325 ± 27
3/4 – 10 UNC	93 ± 12	140 ± 20	190 ± 27	265 ± 25	359 ± 34	375 ± 35	508 ± 47
3/4 – 16 UNF	115 ± 15	165 ± 25	224 ± 34	300 ± 25	407 ± 34	420 ± 35	569 ± 47
7/8 – 9 UNC	140 ± 20	225 ± 25	305 ± 34	430 ± 45	583 ± 61	600 ± 60	813 ± 81
7/8 – 14 UNF	155 ± 25	260 ± 30	353 ± 41	475 ± 45	644 ± 61	660 ± 60	895 ± 81

NOTE: Reduce torque values listed in the table above by 25% for lubricated fasteners. Lubricated fasteners are defined as threads coated with a lubricant such as oil, graphite, or thread sealant such as Loctite.

NOTE: Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

NOTE: The nominal torque values listed above for Grade 5 and 8 fasteners are based on 75% of the minimum proof load specified in SAE J429. The tolerance is approximately ± 10% of the nominal torque value. Thin height nuts include jam nuts.

Standard Torque for Dry, Zinc Plated, and Steel Fasteners (Metric Fasteners)

Thread Size	Class 8.8 Bolts, Screws, and Studs with Regular Height Nuts (Class 8 or Stronger Nuts)		Class 10.9 Bolts, Screws, and Studs with Regular Height Nuts (Class 10 or Stronger Nuts)	
M5 X 0.8	57 ± 5 in–lb	640 ± 60 N–cm	78 ± 7 in–lb	885 ± 80 N–cm
M6 X 1.0	96 ± 9 in–lb	1018 ± 100 N–cm	133 ± 13 in–lb	1500 ± 150 N–cm
M8 X 1.25	19 ± 2 ft–lb	26 ± 3 N–m	27 ± 2 ft–lb	36 ± 3 N–m
M10 X 1.5	38 ± 4 ft–lb	52 ± 5 N–m	53 ± 5 ft–lb	72 ± 7 N–m
M12 X 1.75	66 ± 7 ft–lb	90 ± 10 N–m	92 ± 9 ft–lb	125 ± 12 N–m
M16 X 2.0	166 ± 15 ft–lb	225 ± 20 N–m	229 ± 22 ft–lb	310 ± 30 N–m
M20 X 2.5	325 ± 33 ft–lb	440 ± 45 N–m	450 ± 37 ft–lb	610 ± 50 N–m

NOTE: Reduce torque values listed in the table above by 25% for lubricated fasteners. Lubricated fasteners are defined as threads coated with a lubricant such as oil, graphite, or thread sealant such as Loctite.

NOTE: Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

NOTE: The nominal torque values listed above are based on 75% of the minimum proof load specified in SAE J1199. The tolerance is approximately ± 10% of the nominal torque value.

Other Torque Specifications

SAE Grade 8 Steel Set Screws

Thread Size	Recommended Torque	
	Square Head	Hex Socket
1/4 – 20 UNC	140 ± 20 in–lb	73 ± 12 in–lb
5/16 – 18 UNC	215 ± 35 in–lb	145 ± 20 in–lb
3/8 – 16 UNC	35 ± 10 ft–lb	18 ± 3 ft–lb
1/2 – 13 UNC	75 ± 15 ft–lb	50 ± 10 ft–lb

Wheel Bolts and Lug Nuts

Thread Size	Recommended Torque**	
7/16 – 20 UNF Grade 5	65 ± 10 ft–lb	88 ± 14 N–m
1/2 – 20 UNF Grade 5	80 ± 10 ft–lb	108 ± 14 N–m
M12 X 1.25 Class 8.8	80 ± 10 ft–lb	108 ± 14 N–m
M12 X 1.5 Class 8.8	80 ± 10 ft–lb	108 ± 14 N–m

** For steel wheels and non–lubricated fasteners.

Thread Cutting Screws (Zinc Plated Steel)

Type 1, Type 23, or Type F	
Thread Size	**Baseline Torque***
No. 6 – 32 UNC	20 ± 5 in–lb
No. 8 – 32 UNC	30 ± 5 in–lb
No. 10 – 24 UNC	38 ± 7 in–lb
1/4 – 20 UNC	85 ± 15 in–lb
5/16 – 18 UNC	110 ± 20 in–lb
3/8 – 16 UNC	200 ± 100 in–lb

Thread Cutting Screws (Zinc Plated Steel)

Thread Size	Threads per Inch		Baseline Torque*
	Type A	Type B	
No. 6	18	20	20 ± 5 in–lb
No. 8	15	18	30 ± 5 in–lb
No. 10	12	16	38 ± 7 in–lb
No. 12	11	14	85 ± 15 in–lb

* Hole size, material strength, material thickness & finish must be considered when determining specific torque values. All torque values are based on non–lubricated fasteners.

Conversion Factors

in–lb X 11.2985 = N–cm
ft–lb X 1.3558 = N–m

N–cm X 0.08851 = in–lb
N–m X 0.7376 = ft–lb

Maintenance

Maintenance procedures and recommended service intervals for the Reelmaster 2000–D are covered in the Traction Unit Operator's Manual. Refer to that publication when performing regular equipment maintenance. Refer to the Engine Operator's Manual for additional engine specific maintenance procedures.

REELMASTER ® 2000–D Maintenance Supervisor's Worksheet

Date: _____

(Duplicate this page for routine use.)

Unit Designation:	TORO I.D. #: _____–_____
Hours:	Service to perform (circle): **A B C D Other**
Technician:	

Remarks:

A – Service (every 50 hours)

- ☐ Inspect Air Filter, Dust Cup, & Burp Valve
- ☐ Lubricate All Grease Fittings
- ☐ Check Engine Belt Tension
- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____

B – Service (every 100 hours)

- ☐ Change Engine Oil Filter
- ☐ Check Traction Belt Tension
- ☐ Change Engine Oil
- ☐ **A – Service required**
- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____

C – Service (every 200 hours)

- ☐ Service Air Filter
- ☐ Replace Fuel Filter/Water Separator
- ☐ Replace Hydraulic Filter
- ☐ Torque Wheel Lug Nuts
- ☐ **A and B – Service Required**
- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____

D – Service (every 400 hours)

- ☐ Replace Hydraulic Fluid
- ☐ Check Battery Level/Connections
- ☐ Inspect Traction Linkage Movement
- ☐ Check Engine RPM (Idle & Full Throttle)
- ☐ **A, B, and C – Service Required**
- ☐ _____
- ☐ _____
- ☐ _____
- ☐ _____

Every 1000 hours or 2 years

- ☐ Replace Moving Hoses
- ☐ Replace Safety Switches
- ☐ Flush Cooling System & Replace Hoses
- ☐ Replace Thermostat
- ☐ Drain and Flush Fuel Tank
- ☐ Drain and Flush Hydraulic Tank
- ☐ _____
- ☐ _____
- ☐ _____

Additional Service Items

- ☐ _____
- ☐ _____
- ☐ _____
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(See Operator's Manual for Specifications and Procedures)

Chapter 3

Engine

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BRIGGS & STRATTON/DAIHATSU ENGINE REPAIR MANUAL

Introduction

This Chapter gives information about specifications, troubleshooting, testing, and repair of the Briggs & Stratton/Daihatsu diesel engine used in the Reelmaster 2000–D.

Most repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Special Tools section. The use of some specialized test equipment is explained. However, the cost of the test equipment and the specialized nature of some repairs may dictate that the work be done at an engine repair facility.

Service and repair parts for Briggs & Stratton/Daihatsu diesel engines are supplied through your local Toro Distributor. If no parts list is available, be sure to provide your distributor with the Toro model and serial number.

Specifications

Item	Description
Make / Designation	Briggs & Stratton/Daihatsu, 4–stroke, Liquid Cooled, OHV Diesel
Number of Cylinders	3
Bore x Stroke mm (in.)	68 x 78 (2.68 x 3.07)
Total Displacement cc (cu. in.)	850 (51.9)
Compression Ratio	24.5:1
Firing Order	1 – 2 – 3
Dry Weight (approximate) kg (lb.)	72 (159)
Fuel	Grade No. 2 diesel fuel (ASTM specification)
Fuel Injection Pump	VE (Bosch) type
Fuel Injector Nozzle	Bosch throttle type
Fuel Tank Capacity liter (U.S. gal.)	25 (6.5)
Governor	Mechanical
Idle Speed (no load)	1540 $\pm$ 50 RPM
High Idle (no load)	3200 $\pm$ 50 RPM
Engine Oil	SAE 10W30, API CF or better
Oil Pump	Gear driven trochoid type
Crankcase Oil Capacity liter (U.S. qt.)	3.3 (3.5) with filter
Water Pump	Belt driven centrifugal type
Cooling System Capacity liter (U.S. qt.)	4.7 (5.0)
Starter	12 VDC 1.2 KW
Alternator/Regulator	12 VDC 40 AMP

Fuel Shutoff Valve

This valve (Fig. 1) should be shut when removing the fuel tank or engine from the machine or when placing the unit in long term storage.

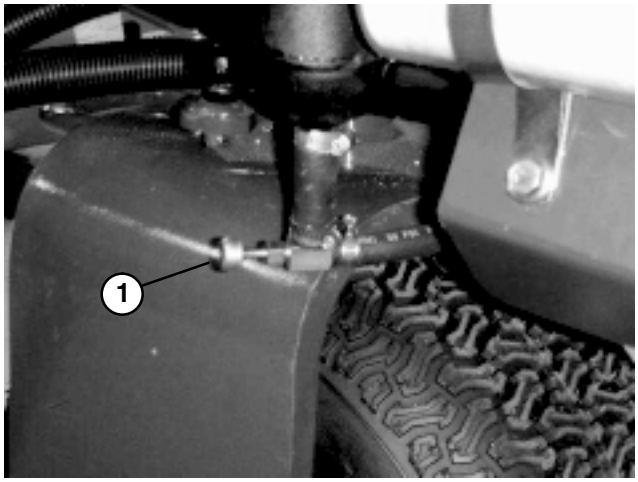

Figure 1

1. **Fuel shutoff valve (under the fuel tank)**

Adding Oil to Engine

When adding oil to the engine, maintain clearance between the oil fill device and the oil fill opening in the valve cover (Fig. 2). This clearance is necessary to allow venting when adding engine oil which will prevent oil from running into the breather tube and intake system.

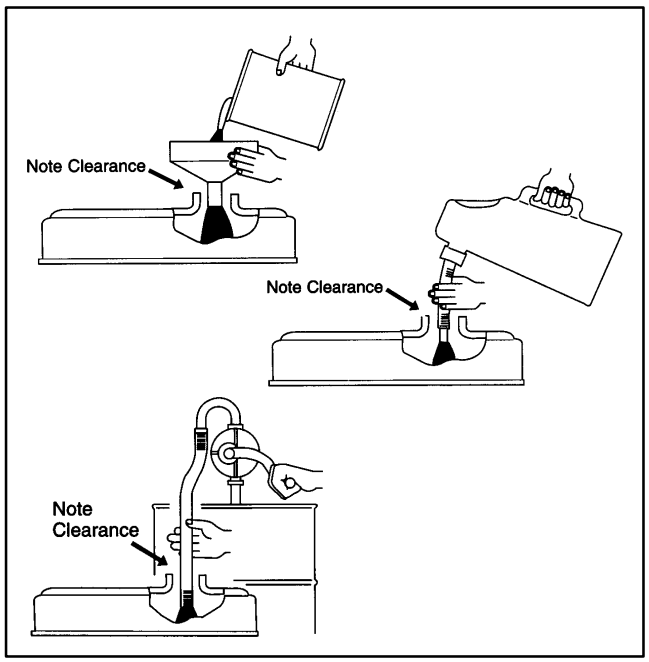

Figure 2

Adjustments

Adjust Throttle Control

Proper throttle operation is dependent upon proper adjustment of throttle control. Make sure throttle control is operating properly.

1. Move remote throttle control lever to **FAST** position.

2. Check position of speed control lever on fuel injection pump. Speed control lever should be contacting high speed screw when throttle control lever is in **FAST** position.

3. If necessary, throttle control can be adjusted by loosening cable clamp screw and repositioning control cable until speed control lever contacts high speed screw.

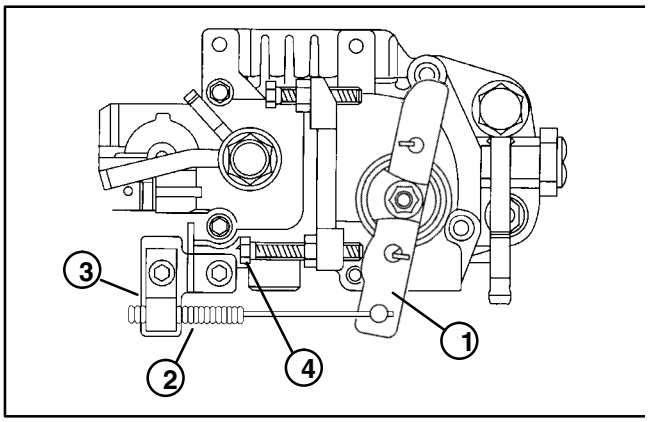

Figure 3

1. **Speed control lever**
2. **Throttle control cable**
3. **Cable clamp**
4. **High speed screw**

Adjust Engine Speed

1. Allow engine to reach operating temperature before checking or adjusting engine speed. Park machine on a level surface, lower cutting units, and engage parking brake.

2. With engine running, move remote throttle control lever to **FAST** position.

3. Using a tachometer, check that engine is operating at **3200 ± 50 RPM**.

4. If high idle speed is incorrect, adjust high speed screw on fuel injection pump (Fig. 4).

   A. Loosen lock nut on high speed screw.

   B. Adjust high speed screw to obtain **3200 ± 50 RPM**.

   C. Tighten lock nut. Recheck high speed.

5. Move remote throttle control lever to **SLOW** position.

6. Using a tachometer, check that engine is operating at **1540 ± 50 RPM**.

7. If idle speed is incorrect, adjust idle speed screw (Fig. 5).

   A. Loosen lock nut on idle speed screw.

   B. Adjust idle speed screw to obtain **1540 ± 50 RPM**.

   C. Tighten lock nut. Recheck idle speed.

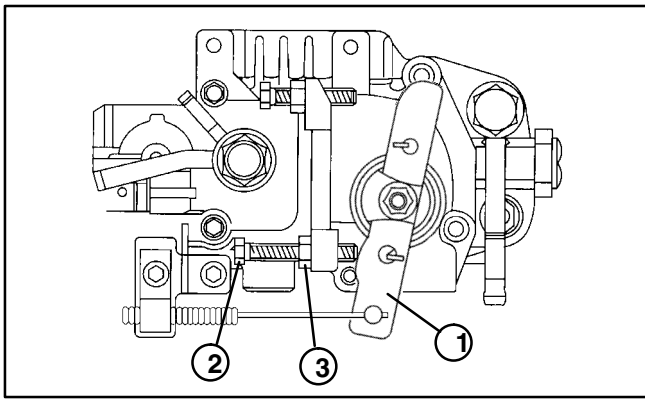

Figure 4

1. **Speed control lever**
2. **High speed screw**
3. **Lock nut**

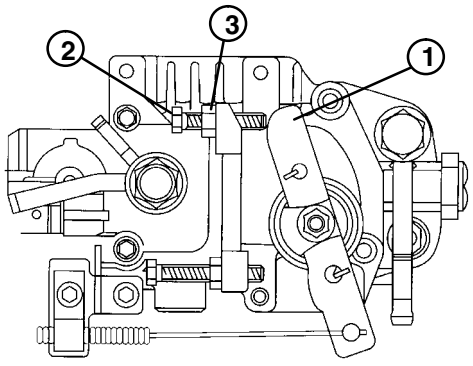

Figure 5

1. **Speed control lever**
2. **Idle speed screw**
3. **Lock nut**

Fuel System

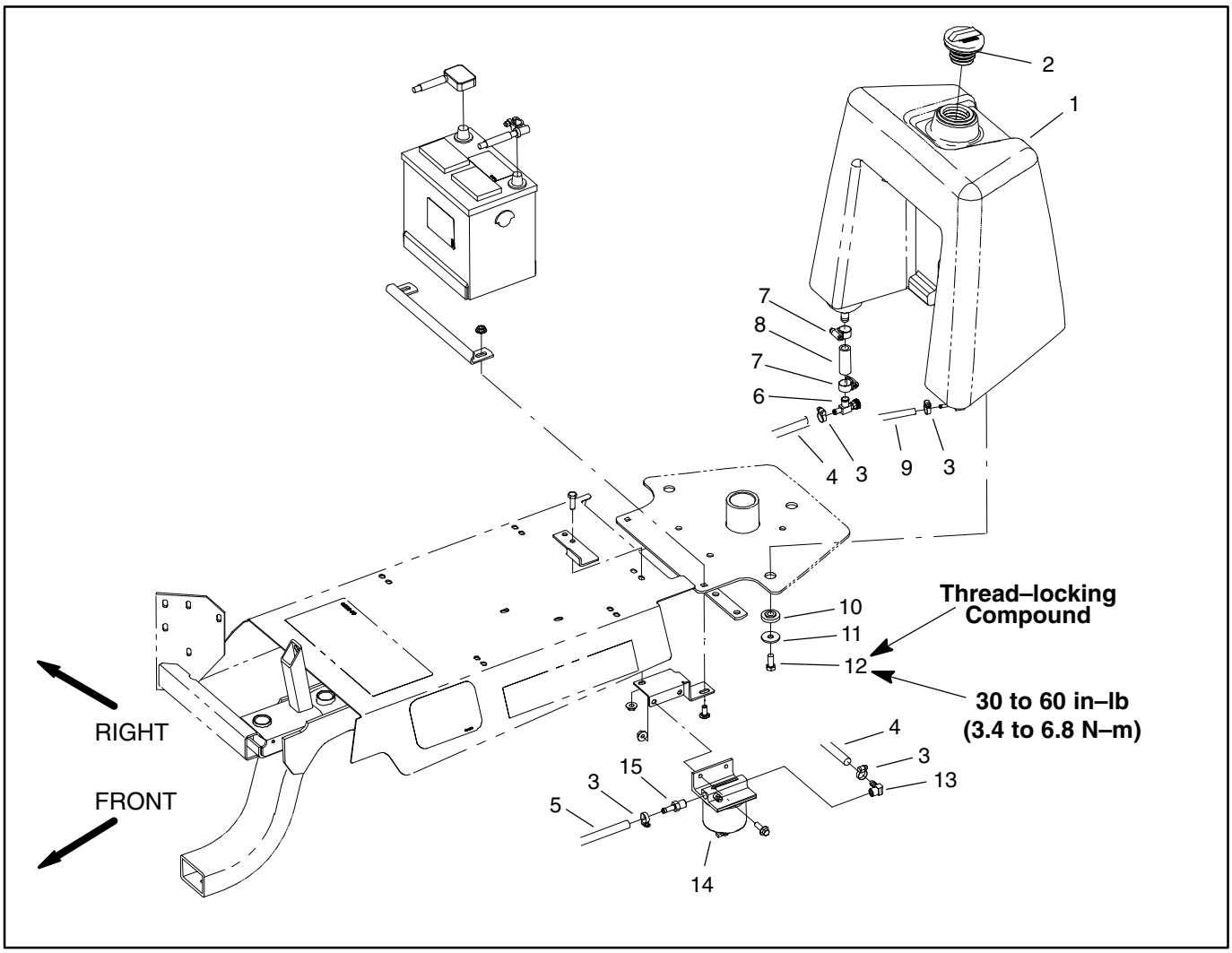

Figure 6

1. Fuel tank
2. Fuel cap
3. Hose clamp
4. Fuel hose
5. Fuel hose (to injector pump)
6. Fuel shut off
7. Hose clamp
8. Fuel hose
9. Return fuel hose (from injector pump)
10. Tank mount grommet
11. Washer
12. Cap screw
13. Fuel fitting
14. Fuel filter/water separator
15. Fuel fitting

DANGER

Because diesel fuel is highly flammable, use caution when storing or handling it. Do not smoke while filling the fuel tank. Do not fill fuel tank while engine is running, hot, or when machine is in an enclosed area. Always fill fuel tank outside and wipe up any spilled diesel fuel before starting the engine. Store fuel in a clean, safety–approved container and keep cap in place. Use diesel fuel for the engine only; not for any other purpose.

Check Fuel Lines and Connections

Check fuel lines and connections periodically as recommended in the Traction Unit Operator's Manual. Check lines for deterioration, damage, leaking, or loose connections. Replace hoses, clamps, and connections as necessary.

Drain and Clean Fuel Tank

Drain and clean the fuel tank periodically as recommended in the Traction Unit Operator's Manual. Also, drain and clean the fuel tank if the fuel system becomes contaminated or if the machine is to be stored for an extended period.

To clean fuel tank, flush tank out with clean diesel fuel. Make sure tank is free of contaminates and debris.

Fuel Tank Removal

1. Park machine on a level surface, lower cutting units, stop engine, engage parking brake, and remove key from the ignition switch.

2. Close fuel tank shut off valve. Disconnect fuel hose from the shut off valve.

3. Use shut off valve to empty fuel tank into a suitable container.

4. Disconnect return fuel hose from fuel tank fitting.

5. Remove fuel tank using Figure 6 as a guide.

Fuel Tank Installation

1. Install fuel tank to frame using Figure 6 as a guide. Apply thread–locking compound to fuel tank cap screws and torque screws from 30 to 60 in–lb (3.4 to 6.8 N–m).

2. Connect fuel hose to the shut off valve. Connect return hose to tank fitting.

3. Fill fuel tank (see Traction Unit Operator's Manual).

Air Cleaner

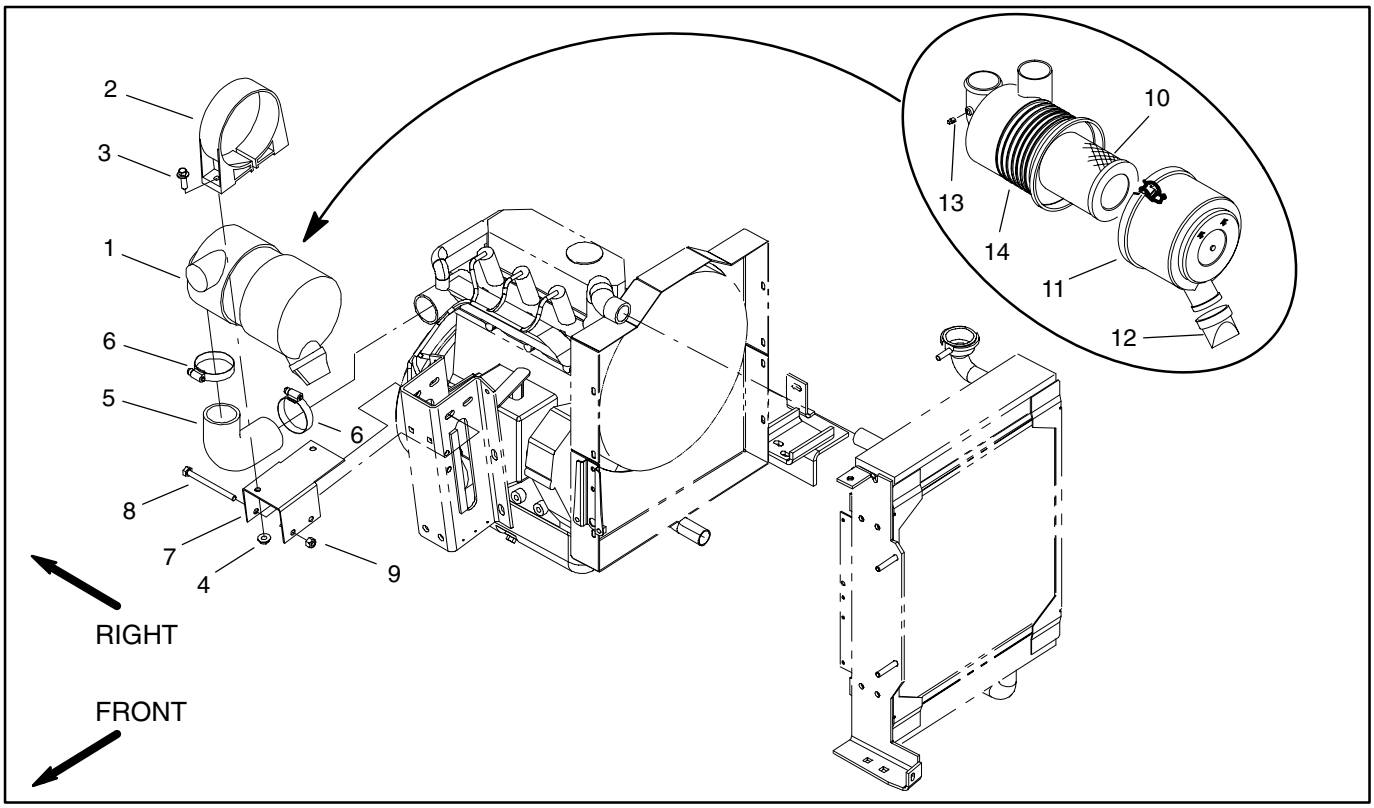

Figure 7

1. **Air cleaner assembly**
2. **Mounting bracket**
3. **Flange head screw**
4. **Flange nut**
5. **Intake air hose**
6. **Hose clamp**
7. **Air cleaner bracket**
8. **Cap screw**
9. **Lock nut**
10. **Filter element**
11. **Air cleaner cover**
12. **Vacuator valve**
13. **Plug**
14. **Air cleaner body**

Removal

1. Remove air cleaner components as needed using Figure 7 as a guide.

Installation

IMPORTANT: Any leaks in the air filter system will cause serious engine damage. Make sure that all air cleaner components are in good condition and are properly secured during reassembly.

1. Reassemble air cleaner system using Figure 7 as a guide.

2. See Traction Unit Operator's Manual for air cleaner service procedures.

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Exhaust System

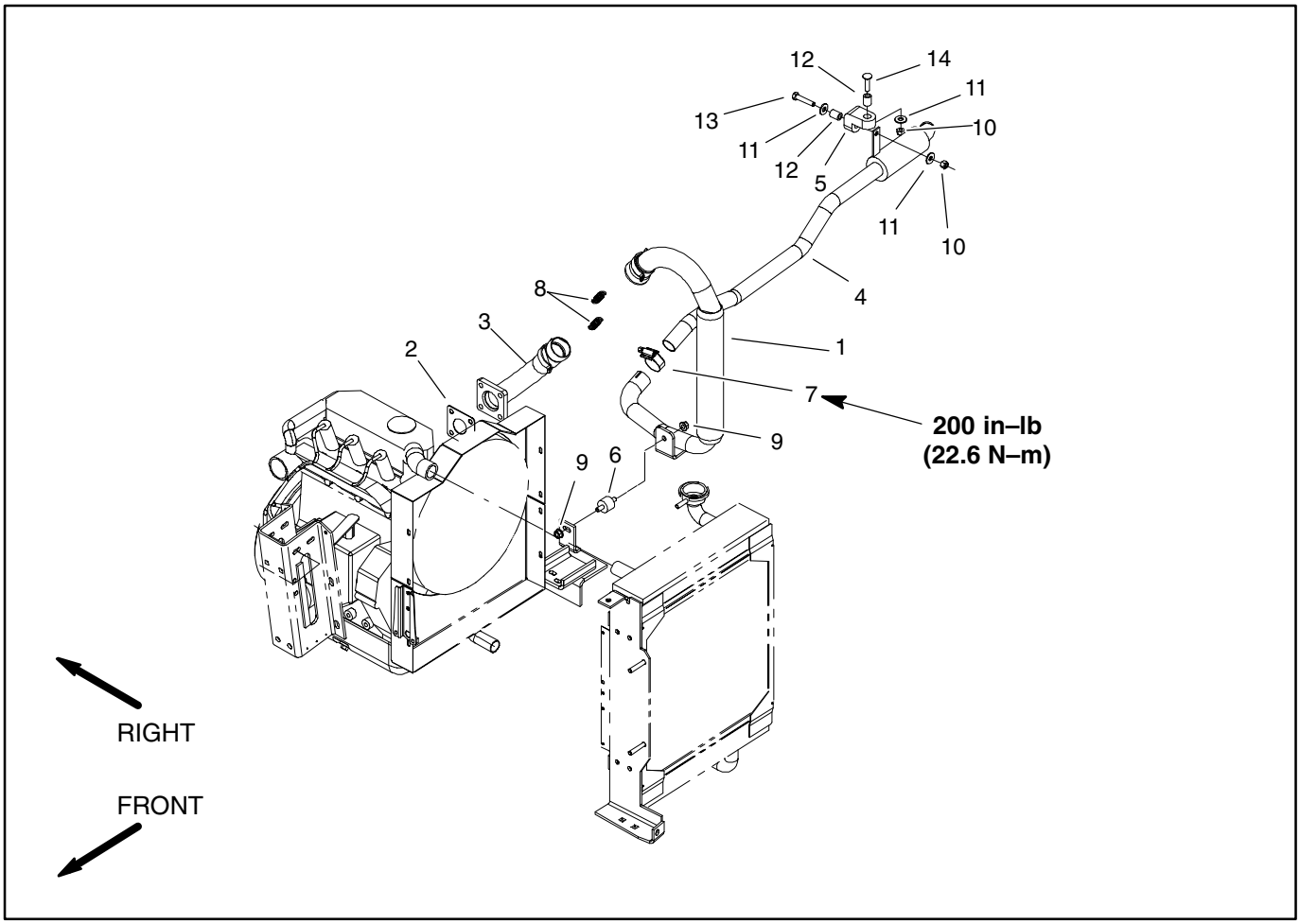

Figure 8

1. **Muffler**
2. **Exhaust gasket**
3. **Muffler header**
4. **Tailpipe**
5. **Rubber hanger**
6. **Rubber isolator**
7. **Clamp**
8. **Coupler spring**
9. **Flange nut**
10. **Lock nut**
11. **Flat washer**
12. **Spacer**
13. **Cap screw**
14. **Carriage screw**

Removal (Fig. 8)

CAUTION

The muffler and exhaust pipe may be hot. To avoid possible burns, allow the engine and exhaust system to cool before working on the exhaust system.

1. Park machine on a level surface, lower cutting units, stop engine, engage parking brake, and remove key from the ignition switch.

2. Remove the hood (see Traction Unit Operator's Manual).

3. Loosen clamp that secures tailpipe to muffler.

4. Remove lock nut, washers, and cap screw securing the tailpipe to the rubber hanger. Slide tailpipe from machine.

5. Remove coupler springs that retain muffler to header.

6. Remove flange nut that secures muffler to rubber isolator. Remove muffler from machine.

7. If muffler header removal is required, remove four hex nuts and lock washers from the exhaust manifold studs. Separate muffler header from the exhaust manifold.

8. Remove exhaust gasket. Replace gasket if damaged or torn.

Installation (Fig. 8)

NOTE: Make sure exhaust manifold and muffler header sealing surfaces are free of debris or damage that may prevent a tight seal.

1. If muffler header was removed, place exhaust gasket on the exhaust manifold. Secure muffler header to the manifold with four lock washers and hex nuts.

IMPORTANT: Finger tighten all fasteners before securing so there is no preload on exhaust components.

2. Position muffler to muffler header and rubber isolator. Install flange nut to rubber isolator.

3. Tighten muffler flange hex nuts and then muffler plate screws and nuts.

4. Place clamp on tailpipe and position tailpipe to muffler. Install cap screw, washers, and lock nut securing the tailpipe to the rubber hanger.

5. Install coupler springs to secure muffler to header. Tighten flange nut at rubber isolator.

6. Torque muffler tailpipe clamp to 200 in–lb (22.6 N–m). Tighten lock nut (at rubber hanger) to secure tailpipe.

7. Install the hood (see Traction Unit Operator's Manual).

Radiator

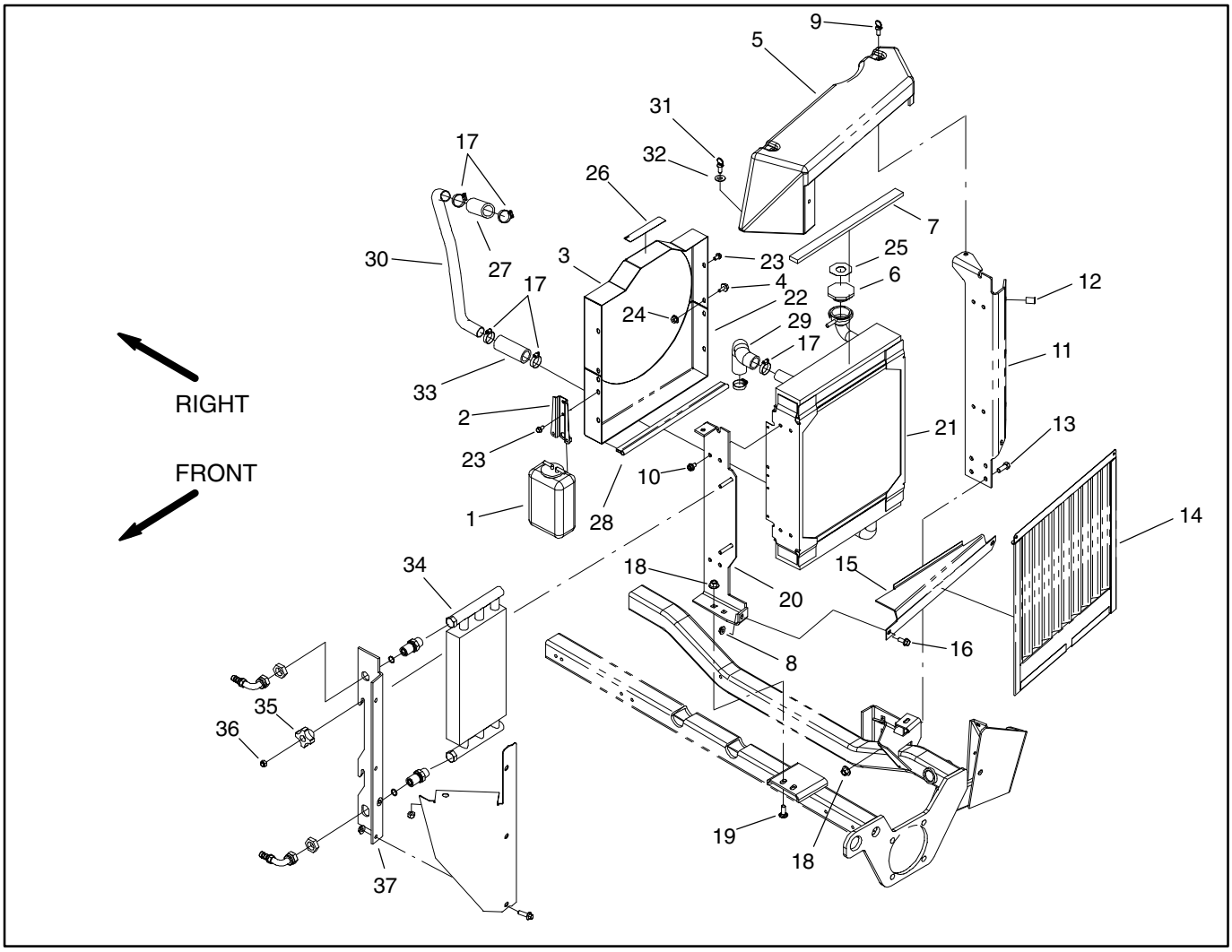

Figure 9

1. Radiator surge tank
2. Surge tank bracket
3. Top radiator shroud
4. Flange head screw
5. Left cover
6. Radiator cap
7. Top foam
8. Flange nut
9. Thumb screw
10. Flange head screw
11. Rear radiator bracket
12. Threaded insert
13. Cap screw
14. Screen
15. Bottom radiator shield
16. Screw
17. Hose clamp
18. Flange nut
19. Carriage screw
20. Front radiator bracket
21. Radiator
22. Bottom radiator shroud
23. Flange head screw
24. Flange nut
25. Radiator cap decal
26. Warning decal
27. Radiator hose
28. Bulb seal
29. Top radiator hose
30. Radiator tube
31. Flange head screw
32. Flat washer
33. Radiator hose
34. Oil cooler
35. Knob
36. Lock nut
37. Oil cooler bracket

Removal (Fig. 9)

1. Park machine on a level surface, lower cutting units, stop engine, engage parking brake, and remove key from the ignition switch.

2. Open and remove the hood (see Traction Unit Operator's Manual).

CAUTION

Do not open radiator cap or drain coolant if the radiator or engine is hot. Pressurized, hot coolant can escape and cause burns.

Ethylene–glycol antifreeze is poisonous. Dispose of coolant properly, or store it in a properly labeled container away from children and pets.

3. Drain coolant from radiator.

   A. Slowly remove radiator cap from the radiator.

   B. Place drain pan below the radiator drain plug located on the bottom of the radiator. Remove plug and allow coolant to drain.

4. Loosen knobs that secure oil cooler to front radiator bracket. Unhook and position oil cooler assembly away from radiator.

5. Disconnect radiator hoses (upper and lower) from the radiator.

6. Support the radiator assembly before loosening mounting fasteners.

7. Remove two carriage screws and flange nuts securing the front radiator bracket to the frame. Remove four cap screws and flange nuts securing the rear radiator bracket to the frame.

8. Carefully pull radiator assembly from the machine. Plug radiator and hose openings to prevent contamination.

9. As required, remove brackets and shrouds from radiator using Figure 9 as a guide.

Installation

1. Install any removed brackets or shrouds to radiator using Figure 9 as a guide.

2. Remove any plugs used during the removal procedure.

3. Carefully position radiator assembly to the frame. Secure radiator with two carriage screws and flange nuts at the front radiator bracket and four cap screws and flange nuts at the rear radiator bracket.

4. Position and secure oil cooler to front radiator bracket.

IMPORTANT: Make sure lower radiator hose doesn't contact fan belt after assembly.

5. Connect hoses (upper and lower) to the radiator.

6. Make sure radiator drain plug is tight. Fill radiator with coolant (see Traction Unit Operator's Manual).

7. Install hood on the machine.

Engine Removal

1. Park machine on a level surface, lower cutting units, stop engine, and remove key from the ignition switch. Chock wheels to keep the machine from moving.

2. Disconnect positive (+) and then negative (–) battery cables at the battery.

3. Gain access to the engine.

   A. Open and remove hood from the machine (see Traction Unit Operator's Manual).

   B. Remove right side panel to gain access to the traction pump drive belt.

   C. Remove left rear panel (radiator side) which supports the instrument panel.

4. Remove left fender and fender bracket from the radiator side of the frame (Fig. 10).

   A. Remove cap screw and flange nut holding the left footrest to the left fender.

   B. Remove remaining cap screws and flange nuts securing the left fender to the fender bracket and frame. Remove fender from the frame.

   C. Remove both flange head screws and left fender bracket from the frame.

5. Remove cotter pin from brake rod. Disconnect brake rod from brake lever (Fig. 11).

6. Remove cap screws and flange nut securing the left footrest to the frame (Fig. 10). Remove the left foot rest from the machine.

7. Drain and remove radiator (see Radiator removal).

8. Drain and remove hydraulic reservoir (see Hydraulic Reservoir in Service and Repair section of Chapter 4 – Hydraulic System).

9. Remove exhaust system (see Exhaust System Removal).

10. Remove air cleaner (see Air Cleaner Removal).

11. Remove throttle cable from injector pump (Fig. 12).

    A. Loosen swivel clamp cap screw enough to separate the throttle cable from the swivel clamp on the injector pump speed control lever.

    B. Loosen cable clamp screw. Remove throttle cable from the injector pump.

    C. Position throttle cable away from the engine.

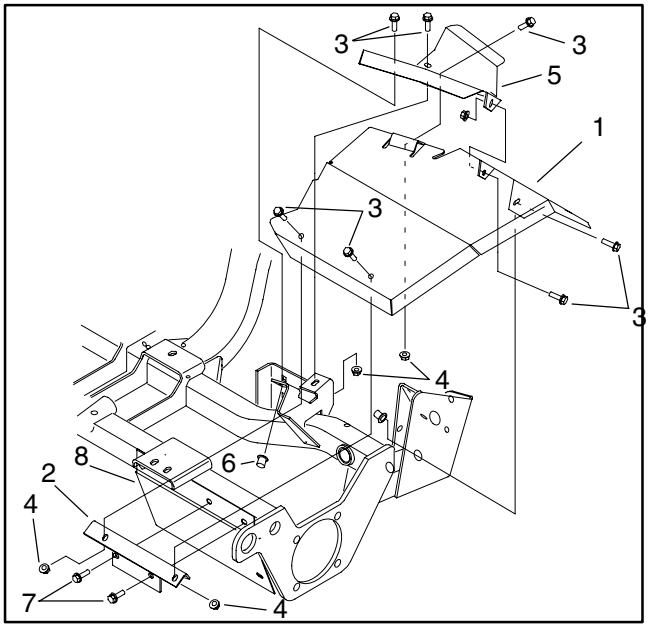

Figure 10

1. **Left fender**
2. **Left fender bracket**
3. **Cap screw**
4. **Flange nut**
5. **Left footrest**
6. **Clinch nut**
7. **Flange head screw**
8. **Grass shield**

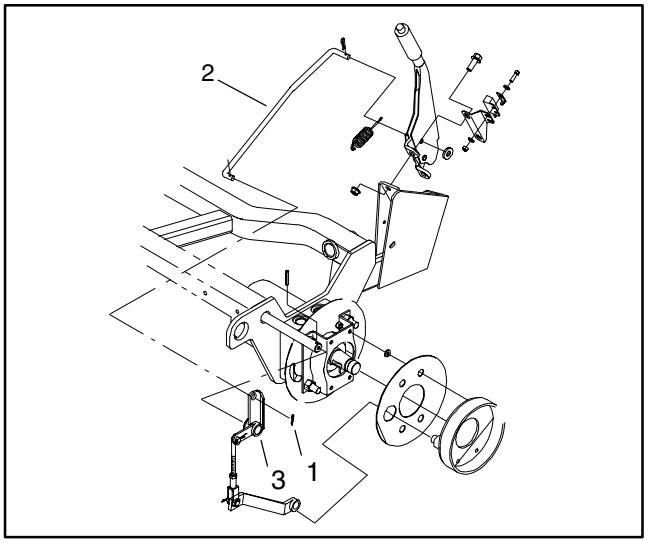

Figure 11

1. **Cotter pin**
2. **Brake rod**
3. **Brake lever**

12. Close fuel tank shut–off valve.

13. Disconnect hoses from engine.

    A. Loosen clamps and disconnect upper and lower radiator hoses from the engine.

    B. At injector pump, loosen hose clamp and disconnect fuel hose from the fuel filter/water separator (Fig. 12). Plug hose to prevent leakage and contamination.

    C. At injector pump, loosen hose clamp and disconnect the return to tank fuel hose (Fig. 12). Plug hose to prevent leakage and contamination.

14. Disconnect electrical connections.

NOTE: Label all electrical leads for reassembly purposes.

    A. Unplug connector with pink and white wires from the alternator. Remove connector with red wire from alternator stud.

    B. Unplug connector with blue/white wire from the high temperature shut down switch located on the water pump behind the fan.

    C. Unplug connector with red/black wire from the fuel valve solenoid in the injector pump.

    D. Unplug connector with gray wire from the oil pressure switch located near the engine oil dipstick.

    E. Remove connector with red wire from the glow plugs located on the rear side of the cylinder head.

    F. Unplug connector with white wire from the engine starter motor located below the exhaust manifold. Remove fusible link connector and positive battery cable from the starter motor (Fig. 13).

    G. Disconnect negative battery cable and black engine wire harness ground wire from the rear side of the cylinder block (Fig. 13).

    H. Remove cap screws and flat washers from R–clamps (Fig. 14). Position wiring harness and hoses away from the engine.

15. Remove hydraulic pump assembly (see Service and Repairs section of Chapter 4 – Hydraulic System).

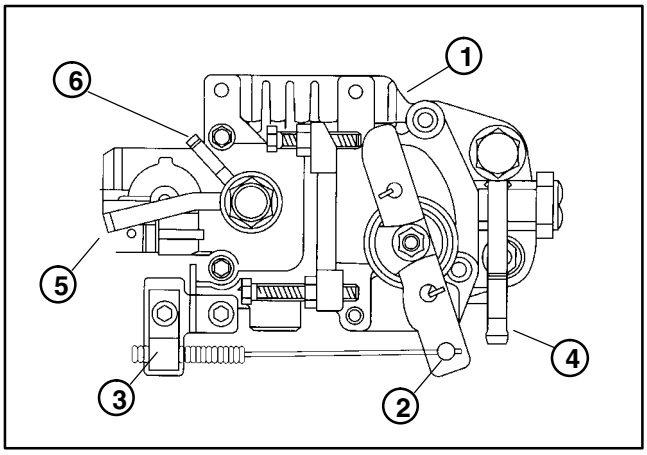

Figure 12

1. **Injector pump**
2. **Swivel clamp and screw**
3. **Cable clamp**
4. **Fuel line: from filter**
5. **Fuel line: return to tank**
6. **Fuel line: injector return**

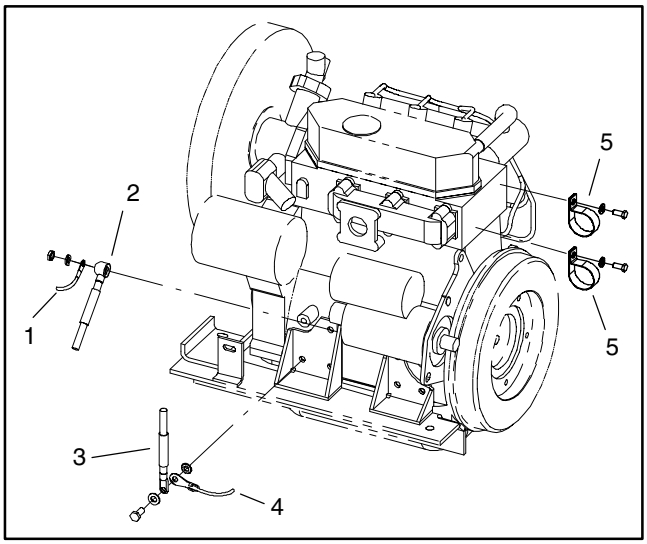

Figure 13

1. **Fusible link harness**
2. **Positive battery cable**
3. **Negative battery cable**
4. **Wire harness ground**
5. **Harness R–clamp**

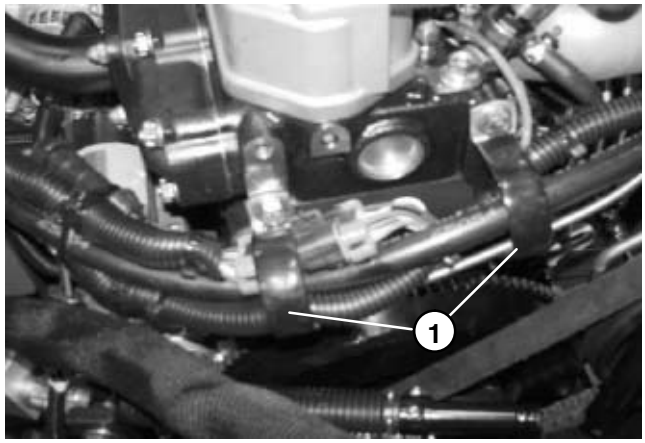

Figure 14

1. **R–clamp locations on cylinder head**

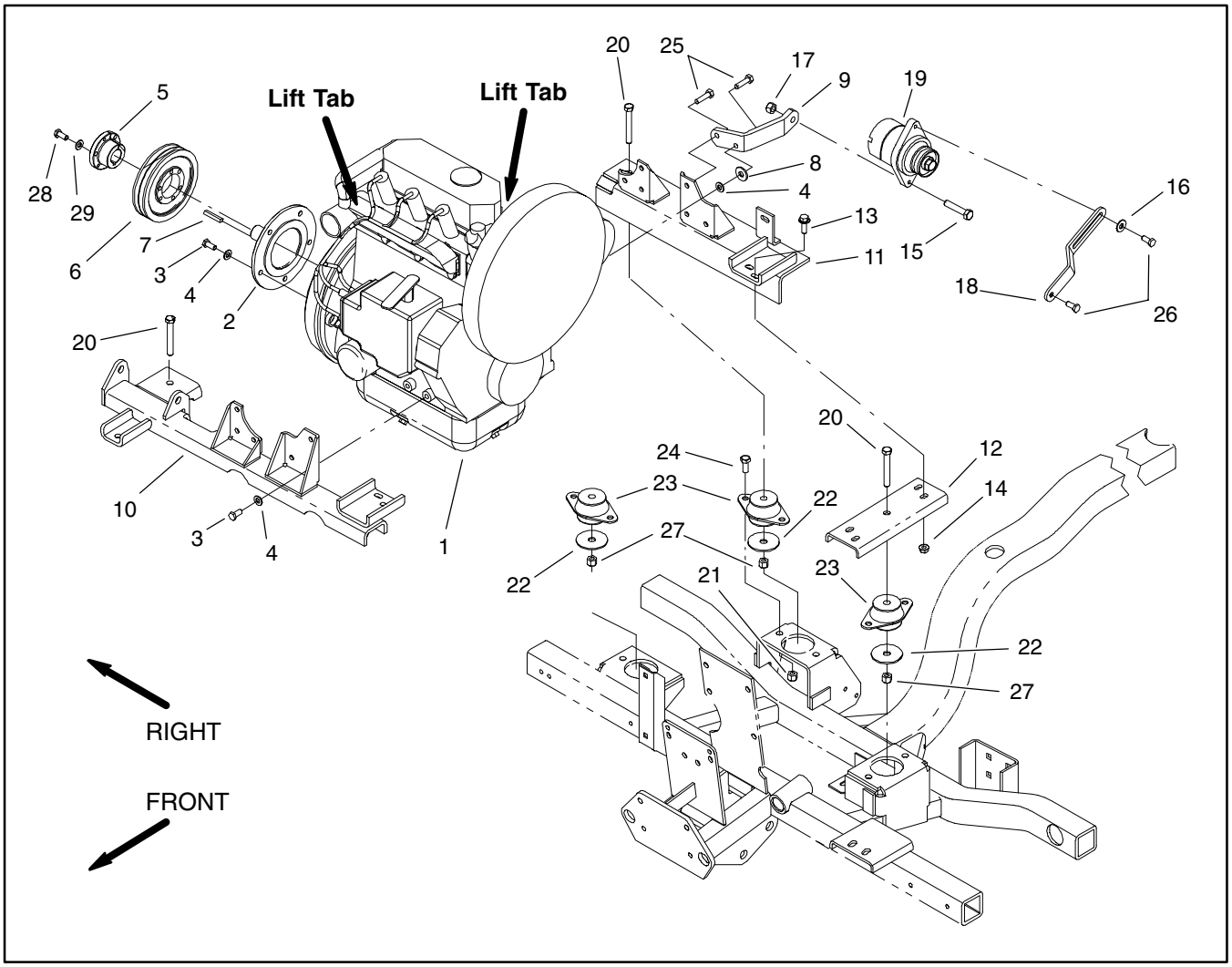

Figure 15

1. Engine
2. Flywheel stub shaft
3. Cap screw
4. Flat washer
5. Bushing
6. Pulley
7. Key
8. Hardened washer
9. Lower alternator bracket
10. Front engine frame
11. Rear engine frame
12. Engine channel
13. Flange head screw
14. Flange nut
15. Cap screw
16. Flat washer
17. Lock nut
18. Upper alternator bracket
19. Alternator
20. Cap screw
21. Lock nut
22. Snubbing washer
23. Engine mount
24. Cap screw
25. Cap screw
26. Cap screw
27. Lock nut
28. Cap screw
29. Lock washer

16. Remove engine from machine (Fig. 15).

A. Attach short section of chain between lift tabs located on each end of the cylinder head.

B. Connect a hoist or chain fall at the center of the short section of chain. Apply enough tension on the short chain so that the engine will be supported as the engine mount brackets are removed.

C. Remove cap screws, snubbing washers, and lock nuts that secure the engine (with frames and channel) to the engine mounts.

CAUTION

One person should operate lift or hoist while the other person guides the engine out of the machine.

IMPORTANT: Make sure not to damage the engine, fuel hoses, hydraulic lines, electrical harness, or other parts while removing the engine.

D. Remove engine (with engine frames and channel) from the machine.

Engine Installation

1. Locate machine on a level surface with cutting units lowered and key removed from the ignition switch. Chock wheels to keep the machine from moving.

2. Make sure that all parts removed from the engine during maintenance or rebuilding are reinstalled to the engine.

3. If engine frames or channel were removed from the engine, reinstall them as follows (Fig. 15):

   A. For front engine frame, secure frame to the engine with six cap screws and washers.

   B. For rear engine frame, secure RH frame bracket (closest to flywheel) to the engine with three cap screws and washers. Secure LH frame bracket with cap screw and washer in the lower RH hole (Fig. 16). Lower LH hole in LH bracket is location for electrical ground connections. Mount alternator bracket using longer cap screws; use hardened washer and flat washer as spacers between alternator bracket and engine block (Fig. 15).

   C. For engine channel, secure channel to the front and rear engine frames with four flange head screws and flange nuts.

4. Reinstall engine to machine.

   A. Attach short section of chain between lift tabs located on each end of the cylinder head

   B. Connect a hoist or chain fall at the center of the short section of chain. Apply enough tension on the short chain so that the engine can be supported.

CAUTION

One person should operate lift or hoist while the other person guides the engine out of the machine.

IMPORTANT: Make sure not to damage the engine, fuel hoses, hydraulic lines, electrical harness, or other parts while removing the engine.

   C. Reinstall engine to the machine. Make sure fastener holes of the engine frames and channel are aligned with the holes in the engine mounts.

   D. Secure engine (with frames and channel) to the engine mounts with cap screws, snubbing washers, and lock nuts.

5. Reconnect electrical connections.

   A. Pull wiring harness and hoses into position keeping them from contacting moving parts. Route harness and hoses through R–clamps. Install cap screws with flat washers to secure R–clamps to cylinder head (Fig. 14).

   B. Install connector with pink and white wires to the alternator. Secure red wire to alternator stud.

   C. Install connector with blue/white wire to the high temperature shut down switch located on the water pump behind the fan.

   D. Install connector with red/black wire to the fuel valve solenoid in the injector pump.

   E. Install connector with gray wire to the oil pressure switch located near the engine oil dipstick.

   F. Install connector with red wire to the glow plugs located on the rear side of the cylinder head.

   G. Install connector with white wire to the engine starter motor located below the exhaust manifold. Install fusible link connector and positive battery cable to the starter motor (Fig. 13).

   H. Connect negative battery cable and black engine wire harness ground wire to the LH bracket of the rear engine frame (Fig. 16).

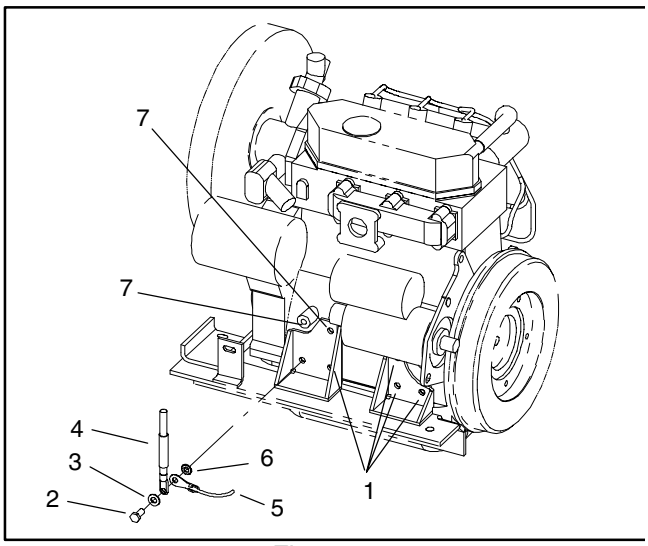

Figure 16

1. Cap screw with washer
2. Cap screw
3. Flat washer
4. Negative battery cable
5. Wire harness ground
6. Star washer
7. Alternator bracket mount

6. Install hydraulic pump assembly (see Service and Repairs section of Chapter 4 – Hydraulic System).

7. After engine and pump installation, verify pulley alignment across engine and pump pulley faces with a straight edge. The gap between both faces must not exceed 0.030" (0.8 mm).

8. Adjust traction pump belt (see Traction Unit Operator's Manual).

9. Reconnect throttle cable to injector pump.

   A. Route throttle cable to injector pump on engine.

   B. Reinstall the throttle cable into the swivel clamp on the pump speed control lever.

   C. Place cable under cable clamp.

   D. Adjust throttle control (see Adjust Throttle Control).

10. Remove plugs installed in hoses during disassembly. Connect hoses to the engine.

    A. Connect return to tank fuel hose to the injector pump fitting (Fig. 12). Tighten hose clamp.

    B. Connect fuel hose from the fuel filter/water separator (Fig. 12). Tighten hose clamp.

    C. Connect upper and lower radiator hoses to the engine. Tighten hose clamps.

11. Reinstall exhaust system (see Exhaust System Installation).

12. Reinstall air cleaner (see Air Cleaner Installation).

13. Reinstall radiator (see Radiator Installation).

14. Add coolant to radiator (see Traction Unit Operator's Manual).

15. Open fuel shut–off valve under the fuel tank.

16. Fill hydraulic reservoir with hydraulic fluid (see Traction Unit Operator's Manual). Check reservoir for leaks.

17. Slide the left foot rest onto the brake rod. Reinstall cap screws and flange nut securing the left footrest to the frame. Tighten cap screws (Fig. 10).

18. Connect brake rod to brake arm. Install and lock cotter pin to the brake rod (Fig. 11).

19. Reinstall fender bracket and left fender to the radiator side of the frame (Fig. 10).

    A. Secure both cap screws and left fender bracket to the frame.

    B. Reinstall remaining cap screws and flange nuts securing the fender to the fender bracket and frame.

    C. Secure cap screw and flange nut to the left foot rest and the left fender.

20. Adjust hand brake (see Traction Unit Operator's Manual).

21. Check engine oil level (see Traction Unit Operator's Manual).

22. Connect negative (–) and then positive (+) battery cables at the battery.

23. Bleed fuel system (see Traction Unit Operator's Manual).

24. Replace access covers to the engine.

    A. Reinstall left rear panel (radiator side) which supports the instrument panel.

    B. Reinstall right side panel which accesses the traction pump drive belt.

    C. Reinstall hood to the machine.

Engine PTO

Disassembly

1. Remove three cap screws and lock washers that secure bushing to pulley.

IMPORTANT: Excessive or unequal pressure on the cap screws can break the bushing flange.

2. Insert cap screws into threaded removal holes of the bushing. Tighten screws progressively and evenly until the pulley is loose on the bushing. Remove bushing and pulley from stub shaft. Locate and remove key.

3. Remove five cap screws and flat washers that secure stub shaft to engine flywheel. Remove stub shaft from engine.

Assembly

1. Position stub shaft to engine flywheel and install cap screws and flat washers. Torque cap screws from 17 to 21 ft–lb (23 to 29 N–m).

2. Install three cap screws and lock washers through non–threaded holes in bushing. Position bushing to pulley to allow cap screws to thread into pulley. Leave cap screws loose.

3. Place key into stub shaft slot. Slide bushing and pulley assembly onto stub shaft while aligning bushing slot to key.

4. Position bushing 1/2” (1.27 mm) from end of stub shaft. Tighten cap screws evenly three times in a rotating pattern to secure bushing and pulley to stub shaft.

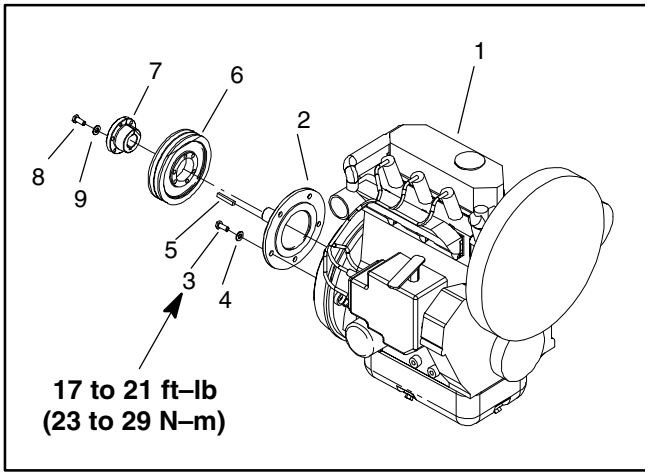

Figure 17

1. **Engine**
2. **PTO stub shaft**
3. **Cap screw**
4. **Flat washer**
5. **Key**
6. **Pulley**
7. **Bushing**
8. **Cap screw**
9. **Lock washer**

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Chapter 4

Hydraulic System

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EATON MEDIUM DUTY PISTON PUMP REPAIR INFORMATION MODEL 70160 VARIABLE DISPLACEMENT PISTON PUMP

ROSS TORQMOTOR™ MG, MF, ME, AND MJ SERIES SERVICE PROCEDURE

Specifications

Item	Description
Traction Pump Maximum Operating Pressure	Variable displacement piston pump 3000 PSI (207 bar)
Wheel Motors Maximum Operating Pressure	Orbital rotor motor (with shuttle valve on left front motor) 2000 PSI (138 bar)
Charge Pump Charge Pressure	Gerotor pump integral in traction pump 100 to 150 PSI (6.9 to 10.0 bar)
Implement (Lift) Relief Valve Implement Relief Pressure	Differential area relief valve 450 – 525 PSI (31.1 to 36.2 bar)
Lift Control Valve	Spool type directional control valve
Reel Motor Gear Pump Maximum Operating Pressure	Positive displacement gear type pump 4000 PSI (276 bar)
Hydraulic Manifold Relief Valve Cutting Circuit Relief Pressure	Differential area relief valve 2700 to 3300 PSI (186.3 to 227.7 bar)
Reel Motor Maximum Operating Pressure Cross–over Relief Pressure	Gear motor 2250 PSI (155 bar) 1350 to 1650 PSI (93.2 to 113.9 bar)
Hydraulic Filter	10 Micron spin–on cartridge type
Hydraulic Oil	See Traction Unit Operator's Manual
Hydraulic Reservoir Capacity	2.3 Gal. U.S. (8.7 L)

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Hydraulic Hoses

Hydraulic hoses are subject to extreme conditions such as pressure differentials during operation and exposure to weather, sun, chemicals, very warm storage conditions, or mishandling during operation and maintenance. These conditions can cause damage or premature deterioration. Some hoses are more susceptible to these conditions than others. Inspect the hoses frequently for signs of deterioration or damage.

When replacing a hydraulic hose, be sure that the hose is straight (not twisted) before tightening the fittings. This can be done by observing the imprint on the hose. Use two wrenches; hold the hose straight with one wrench and tighten the hose swivel nut onto the fitting with the other wrench.

WARNING

Before disconnecting or performing any work on hydraulic system, relieve all pressure in system. Stop engine; lower or support all attachment(s).

Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Use paper or cardboard, not hands, to search for leaks. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury. Gangrene may result from such an injury.

Hydraulic Fitting Installation

O–Ring Face Seal

1. Make sure both threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign material.

2. Make sure the O–ring is installed and properly seated in the groove. It is recommended that the O–ring be replaced any time the connection is opened.

3. Lubricate the O–ring with a light coating of oil.

4. Put the tube and nut squarely into position on the face seal end of the fitting and tighten the nut until finger tight.

5. Mark the nut and fitting body. Hold the body with a wrench. Use another wrench to tighten the nut to the correct Flats From Finger Tight (F.F.F.T.). The markings on the nut and fitting body will verify that the connection has been tightened.

Size	F.F.F.T.
4 (1/4 in. nominal hose or tubing)	0.75 ± 0.25
6 (3/8 in.)	0.75 ± 0.25
8 (1/2 in.)	0.75 ± 0.25
10 (5/8 in.)	1.00 ± 0.25
12 (3/4 in.)	0.75 ± 0.25
16 (1 in.)	0.75 ± 0.25

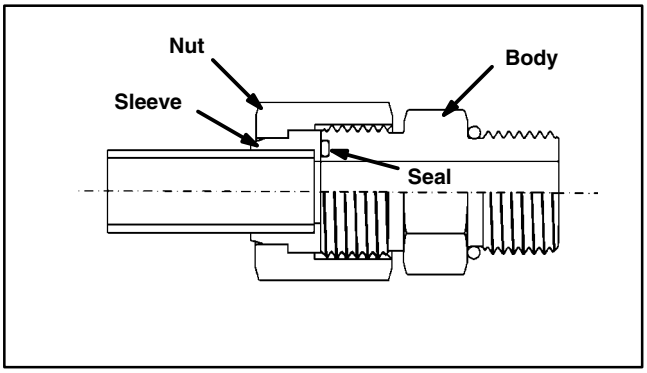


Figure 1

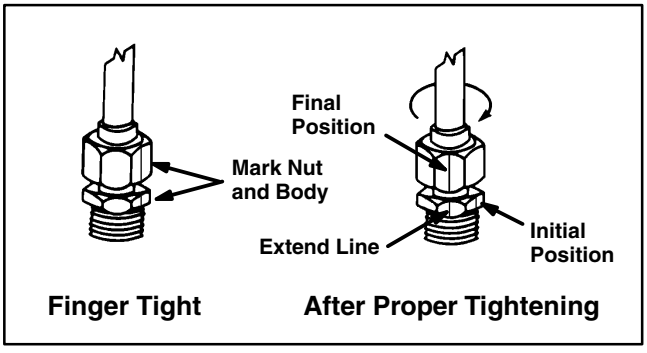


Figure 2

SAE Straight Thread O–Ring Port – Non–adjustable

1. Make sure both threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign material.

2. Always replace the O–ring seal when this type of fitting shows signs of leakage.

3. Lubricate the O–ring with a light coating of oil.

4. Install the fitting into the port and tighten it down full length until finger tight.

5. Tighten the fitting to the correct Flats From Finger Tight (F.F.F.T.).

Size	F.F.F.T.
4 (1/4 in. nominal hose or tubing)	1.00 ± 0.25
6 (3/8 in.)	1.50 ± 0.25
8 (1/2 in.)	1.50 ± 0.25
10 (5/8 in.)	1.50 ± 0.25
12 (3/4 in.)	1.50 ± 0.25
16 (1 in.)	1.50 ± 0.25

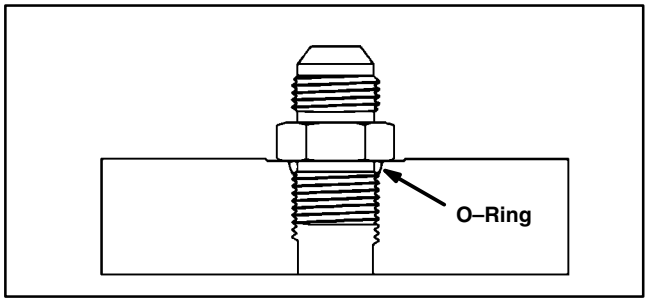


Figure 3

SAE Straight Thread O–Ring Port – Adjustable

1. Make sure both threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign material.

2. Always replace the O–ring seal when this type of fitting shows signs of leakage.

3. Lubricate the O–ring with a light coating of oil.

4. Turn back the jam nut as far as possible. Make sure the back up washer is not loose and is pushed up as far as possible (Step 1).

5. Install the fitting into the port and tighten finger tight until the washer contacts the face of the port (Step 2).

6. To put the fitting in the desired position, unscrew it by the required amount, but no more than one full turn (Step 3).

7. Hold the fitting in the desired position with a wrench and turn the jam nut with another wrench to the correct Flats From Finger Tight (F.F.F.T.) (Step 4).

Size	F.F.F.T.
4 (1/4 in. nominal hose or tubing)	1.00 ± 0.25
6 (3/8 in.)	1.50 ± 0.25
8 (1/2 in.)	1.50 ± 0.25
10 (5/8 in.)	1.50 ± 0.25
12 (3/4 in.)	1.50 ± 0.25
16 (1 in.)	1.50 ± 0.25

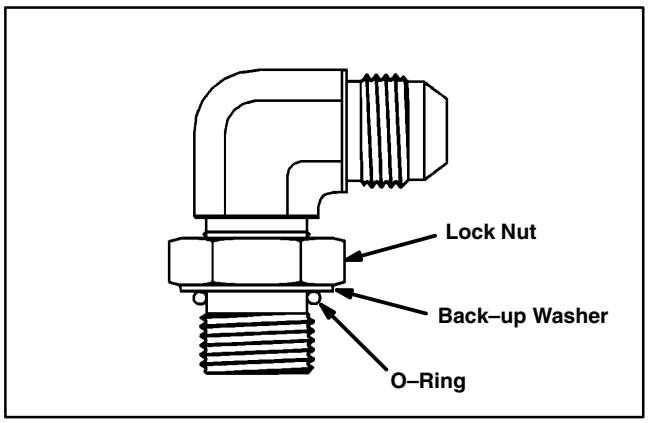


Figure 4

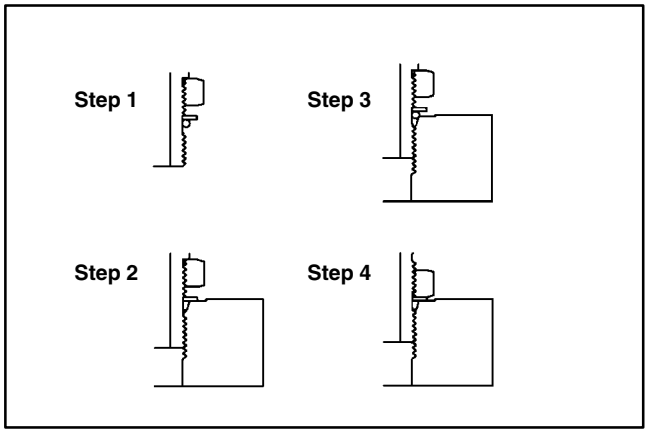


Figure 5

Towing Traction Unit

IMPORTANT: If towing limits are exceeded, severe damage to the piston pump may occur.

If it becomes necessary to tow (or push) the machine, tow (or push) at a speed **below 3 mph (4.8 kph)**, and for a distance **less than 1/4 mile (0.4 km)**. The piston (traction) pump is equipped with a by–pass valve that needs to be turned 90º for towing. See Traction Unit Operator's Manual for Towing Procedures.

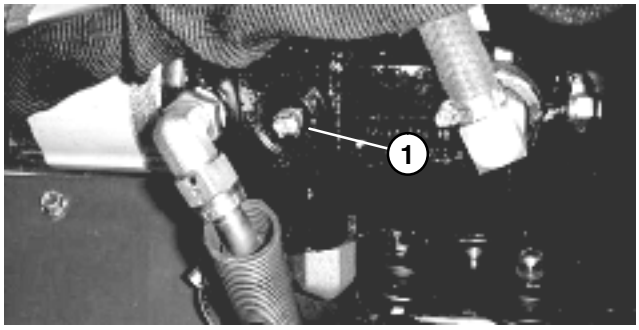


Figure 6

1. **By–pass valve location**

Check Hydraulic Fluid

The Reelmaster 2000–D hydraulic system is designed to operate on anti–wear hydraulic fluid. The reservoir holds about 3.3 gallons (12.5 liters) of hydraulic fluid. **Check level of hydraulic fluid daily.** See Traction Unit Operator's Manual for fluid level checking procedure and oil recommendations.

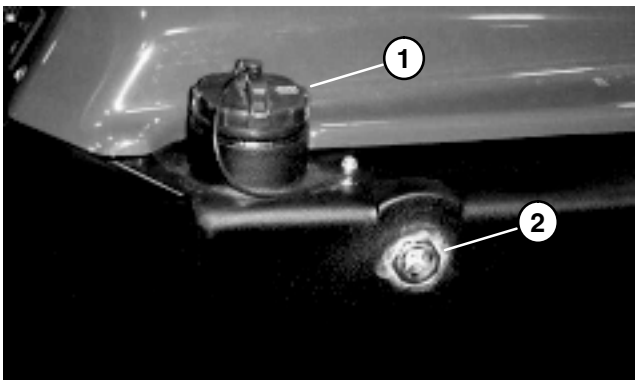
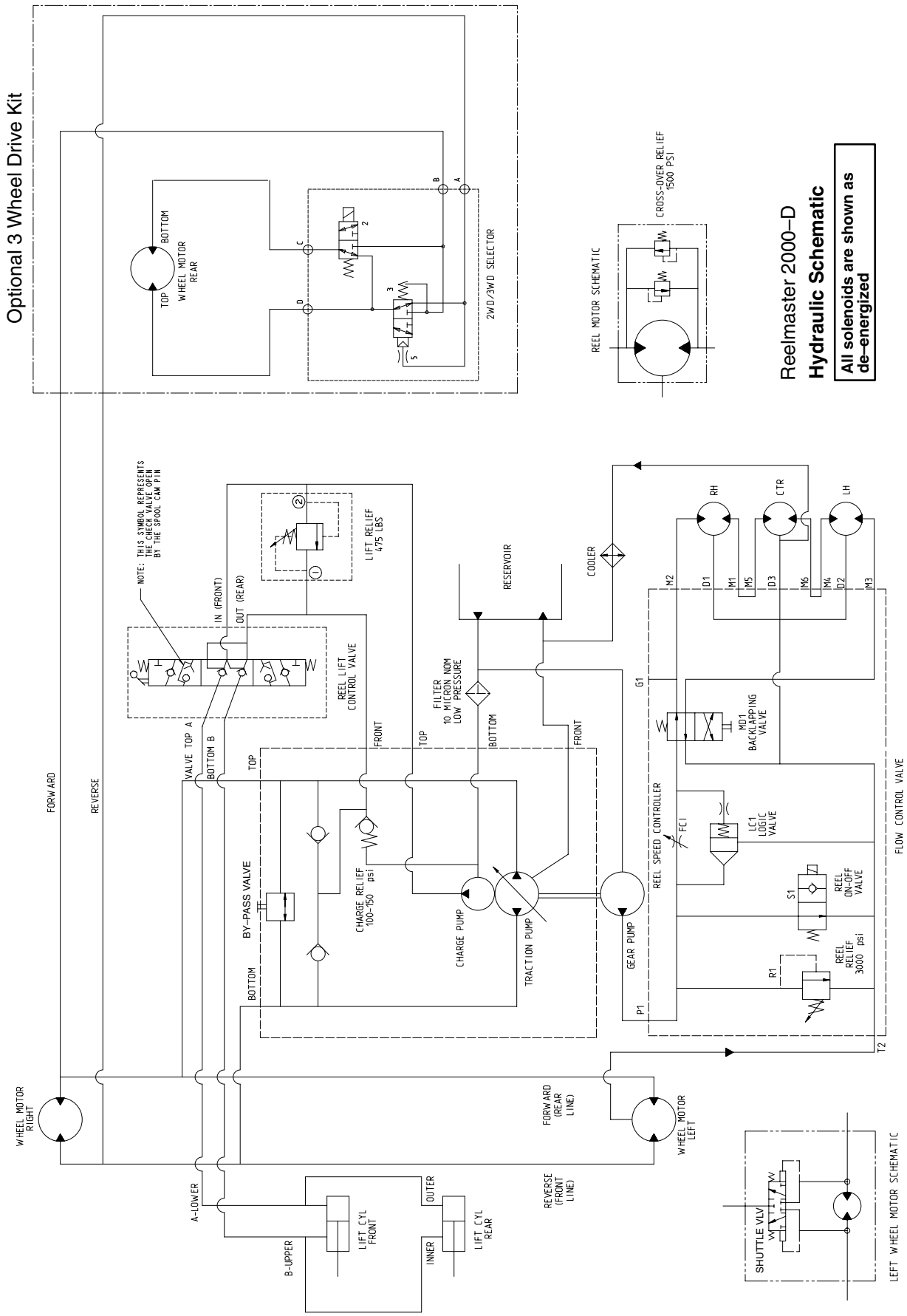


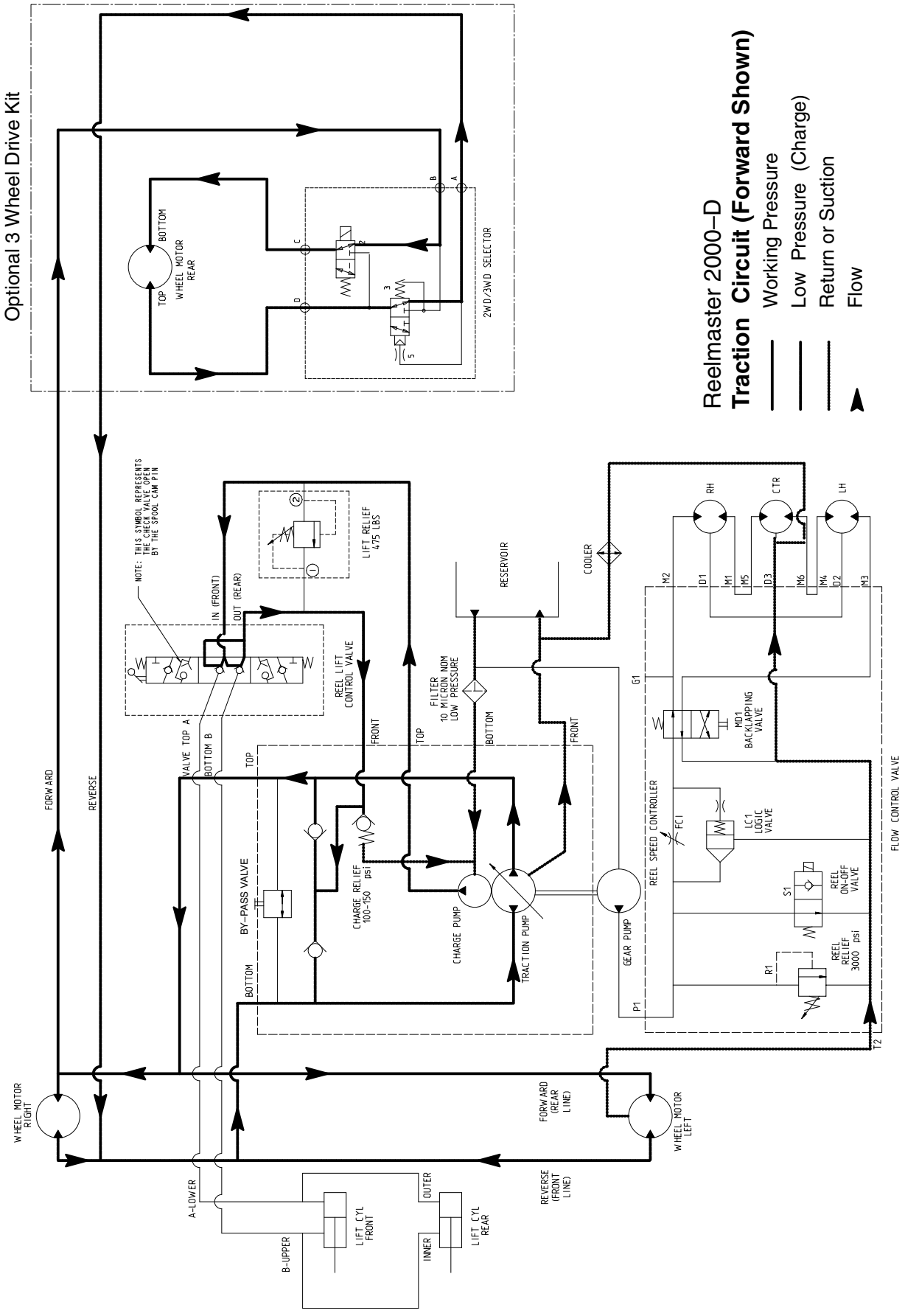
Figure 7

1. **Hydraulic reservoir cap** 2. **Sight gauge**

Hydraulic Schematic



Hydraulic Flow Diagrams



Traction Circuit

Forward Direction

The traction pump is driven by the engine through the pulleys and pump drive belt. The traction circuit of the hydraulic system acts essentially as a closed loop. Taking its suction directly from the return side of the wheel motors of the traction circuit, the traction pump supplies oil flow to the wheel motors through the supply side of the traction circuit.

With the engine running and the traction pedal in the neutral position, the traction pump supplies no flow to the wheel motors. When the traction pedal is pressed to the forward position, the linkage from the pedal positions the swash plate in the traction pump so oil flows out the top port of the pump. Oil flow out of the top port goes to the wheel motors and turns them in the forward direction.

Oil flowing out of the wheel motors returns to the bottom port of the traction pump and is continuously pumped out the top port.

A small amount of hydraulic oil leaves the traction circuit through the bi–directional shuttle valve in the front left wheel motor. This oil is cooled as it flows through the oil cooler and returns to the reservoir.

Filtered hydraulic oil is supplied to the traction circuit from the charge pump, through the lift control valve, and back through the charge circuit check valves. This filtered oil replaces oil losses from flow through the shuttle valve and small amounts of pump and motor leakage. The charge pump and shuttle valve circuits allow for indirect cooling and filtering of the traction circuit.

If the optional 3 Wheel Drive Kit has been installed, the 3WD selector valve allows forward flow to the rear wheel only when the Reel Engagement switch is in the ON position. When the reels are switched on, the solenoid in the 3WD selector valve is energized and shifted, directing hydraulic flow to the rear wheel motor.

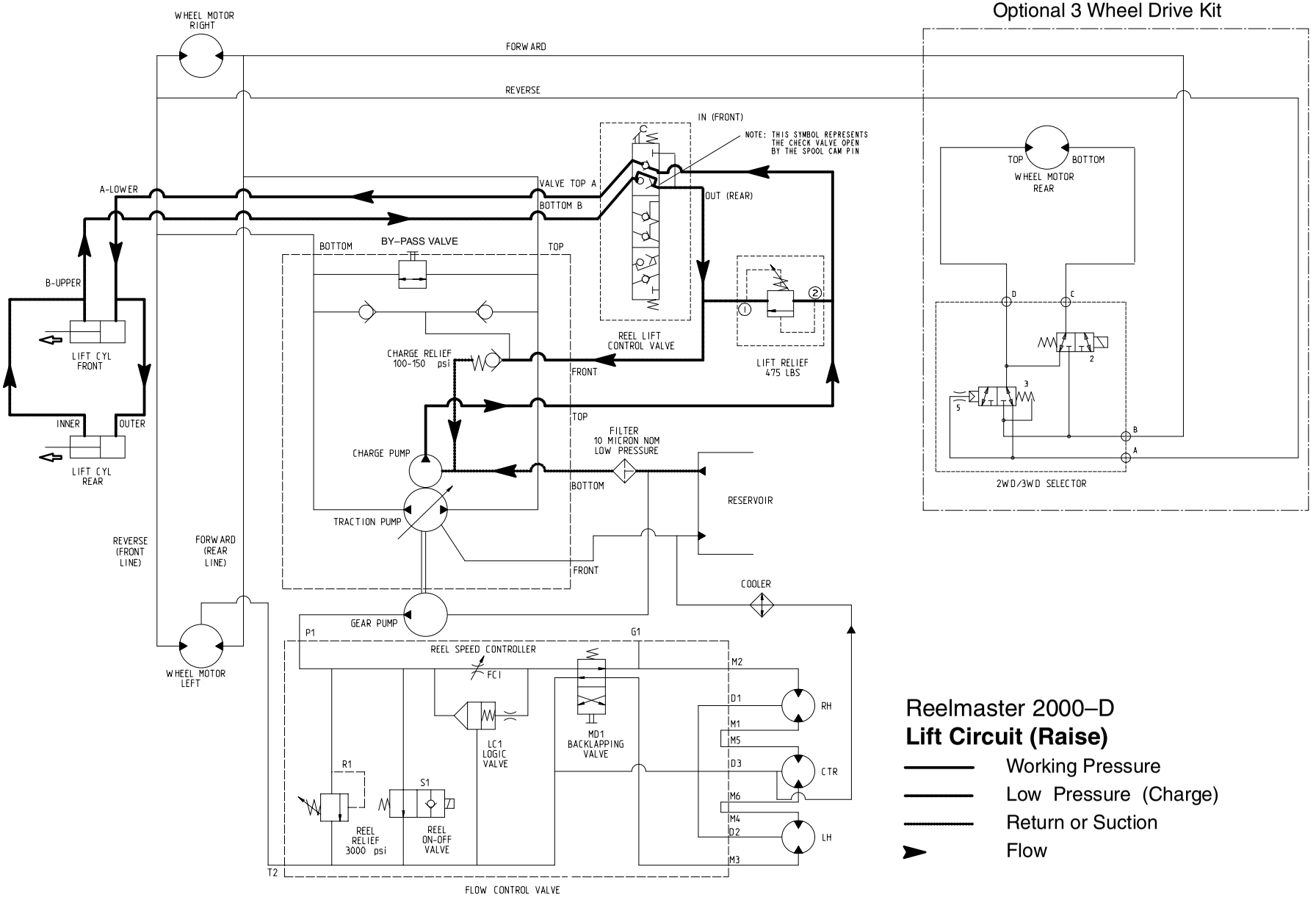
Reverse Direction

The traction circuit operates essentially the same in reverse as it does in the forward direction. However, the flow through the circuit is reversed. When the traction pedal is pressed to the reverse position, the linkage from the pedal positions the swash plate in the traction motor so oil flows out the bottom port of the pump. Oil flow out of the bottom port goes to the wheel motors and turns them in the reverse direction.

Oil flowing out of the wheel motors returns to the top port of the traction pump and is continuously pumped out the bottom port.

The charge and shuttle valve circuits function the same in reverse as they did in the forward direction.

If the optional 3 Wheel Drive Kit has been installed, the pilot directional valve in the 3WD selector valve prevents reverse flow to the rear wheel. As a result, there is no 3WD in reverse.



Reelmaster 2000–D

Lift Circuit (Raise)

- Working Pressure
- Low Pressure (Charge)
- Return or Suction
- Flow

Lift Circuit

The charge pump is part of the traction pump and is directly coupled to it. It supplies hydraulic pressure for raising and lowering cutting units and maintaining 100 to 150 PSI to the low pressure side of the traction circuit (piston pump). The charge pump takes its suction through a filter from the reservoir.

During conditions of not lifting or lowering cutting units, flow from the charge pump goes to the lift control valve and is by–passed (Fig. 8) directly to the suction of the piston pump and the charge relief valve.

Maximum lift/lower circuit pressure (475 PSI) is limited by a relief valve in the lift relief manifold located near the lift control valve.

Raise Cutting Units

When the cutting units are to be raised, the control valve spool is positioned down and flow is directed out the top of the control valve to the lower and outer portions of the lift cylinders. Hydraulic pressure against the cylinder pistons pushes the shafts out. At the same time, the pistons push the hydraulic fluid in the upper and inner portions of the lift cylinders out and through the control valve to the piston pump suction. When the control valve lever is released, spring action returns the spool to the center position and by–passes flow back to the piston pump suction. Lift cylinder movement is stopped. The cylinder position is locked in place since there is no complete circuit of flow to and from the lift cylinders.

Lower Cutting Units

Circuit operation for lowering the lift cylinders is similar to raising them. However, the control valve spool is shifted up and flow is reversed to and from the lift cylinders (Fig. 8), thus moving the cutting units down.

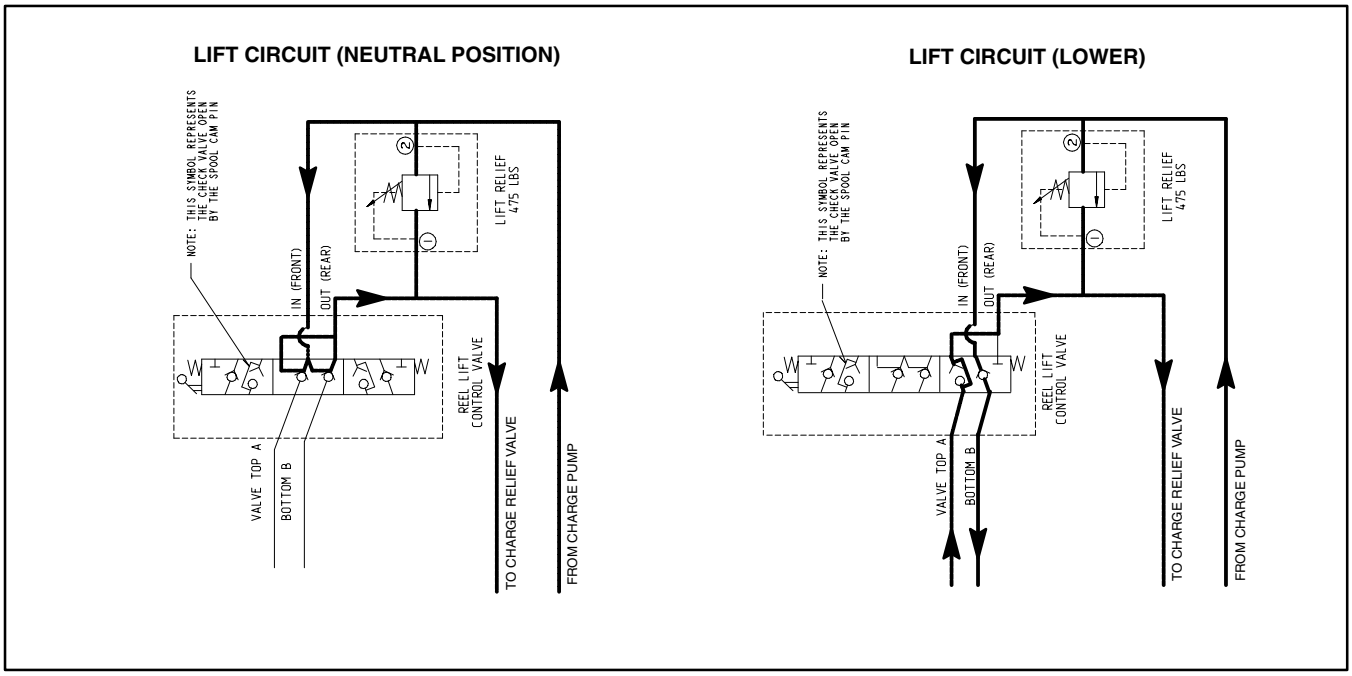
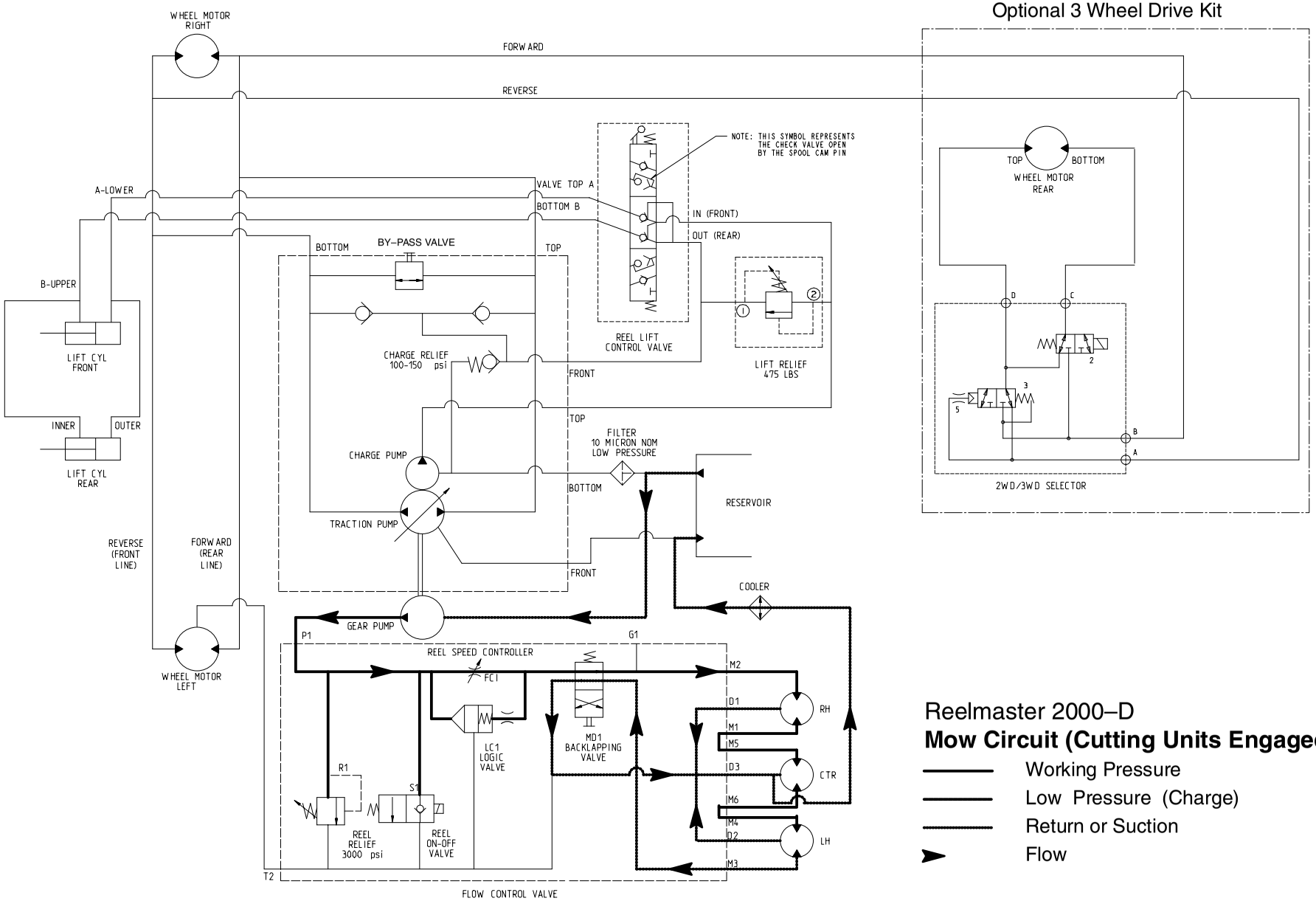

LIFT CIRCUIT (NEUTRAL POSITION)
NOTE: THIS SYMBOL REPRESENTS THE CHECK VALVE OPEN BY THE SPOOL CAM PIN
IN (FRONT)
OUT (REAR)
LIFT RELIEF 475 LBS
REEL LIFT CONTROL VALVE
VALVE TOP A
BOTTOM B
TO CHARGE RELIEF VALVE
FROM CHARGE PUMP
LIFT CIRCUIT (LOWER)
NOTE: THIS SYMBOL REPRESENTS THE CHECK VALVE OPEN BY THE SPOOL CAM PIN
IN (FRONT)
OUT (REAR)
LIFT RELIEF 475 LBS
REEL LIFT CONTROL VALVE
VALVE TOP A
BOTTOM B
TO CHARGE RELIEF VALVE
FROM CHARGE PUMP

Figure 8



Reelmaster 2000–D

Mow Circuit (Cutting Units Engaged)

- Working Pressure
- Low Pressure (Charge)
- Return or Suction
- Flow

Mow Circuit

The reel motor drive pump is directly coupled to the traction pump which is belt driven by the engine. Taking its suction directly from the reservoir, the reel motor drive pump supplies oil flow to the hydraulic manifold block and to the reel motors.

With the engine running and the cutting unit switch in the **DISENGAGED** position, oil flows into inlet port (P1) and through deenergized solenoid valve (S1) bypassing the reel motors. Oil then flows directly back to the reservoir through the oil cooler.

When the cutting unit switch is in the **ENGAGED** position with the engine running, solenoid valve (S1) is energized and shifted, hydraulic system pressure builds up, and flow is diverted to the reel motors. Oil flow from port (P1) flows through the 11 position reel speed control valve. Flow across the speed control valve is pressure compensated by the logic cartridge valve (LC1). Any excess flow above what the speed control valve is set for is bypassed to the reservoir through the logic cartridge valve. With the backlap valve (MD1) in the **MOW** position, oil flows through the valve and reel motors which are connected in series. Oil flows through the right, center, and then left reel motor as it turns the motors in the mow direction. The oil then returns to the reservoir.

Relief valve (R1) limits system pressure and is set at 3000 PSI (207 bar). When the valve opens, oil is diverted back to the reservoir.

Backlapping operation is the same as mowing operation, except for the position of the backlap valve (MD1). When the backlap valve is in the **BACKLAP** position, oil flow is directed through the left, center, and then right reel motor as it turns the motors in the backlap direction.

Special Tools

Order these special tools from your Toro Distributor.

Hydraulic Pressure Test Kit

Toro Part Number: **TOR47009**

Use to take various pressure readings for diagnostic tests. Quick disconnect fittings provided attach directly to mating fittings on machine test ports without tools. A high pressure hose is provided for remote readings. Contains one each: 1000 PSI (70 Bar), 5000 PSI (350 Bar) and 10000 PSI (700 Bar) gauges. Use gauges as recommended in Testing section of this chapter.

Figure 9

Hydraulic Tester (Pressure and Flow)

Toro Part Number: **TOR214678**

This tester requires O−ring Face Seal (ORFS) adapter fittings for use on this machine (see Hydraulic Test Fitting Kit − TOR4079 in this section).

1. INLET HOSE: Hose connected from the system circuit to the inlet side of the hydraulic tester.

2. LOAD VALVE: A simulated working load is created in the circuit by turning the valve to restrict flow.

3. LOW PRESSURE GAUGE: Low range gauge to provide accurate reading at low pressure: 0 to 1000 PSI.

   A protector valve cuts out when pressure is about to exceed the normal range for the gauge. The cutout pressure is adjustable.

4. HIGH PRESSURE GAUGE: High range gauge which accommodates pressures beyond the capacity of the low pressure gauge: 0 to 5,000 PSI.

5. FLOW METER: This meter measures actual oil flow in the operating circuit with a gauge rated at 15 GPM.

6. OUTLET HOSE: A hose from the outlet side of the hydraulic tester connects to the hydraulic system circuit.

Figure 10

Hydraulic Test Fitting Kit

Toro Part Number: **TOR4079**

This kit includes a variety of O–ring Face Seal fittings to enable connection of test gauges to the system.

The kit includes: tee's, unions, reducers, plugs, caps, and male test fittings.

Figure 11

Measuring Container

Toro Part Number: **TOR4077**

Use this container for doing hydraulic motor efficiency testing (motors with case drain lines only). Measure efficiency of a hydraulic motor by restricting the outlet flow from the motor and measuring leakage from the case drain line while the motor is pressurized by the hydraulic system.

The table in Figure 13 provides gallons per minute (GPM) conversion for hydraulic motor case drain leakage measured in either milliliters or ounces.

Figure 12

GPM	Milliliters in 15 sec.	Ounces in 15 sec.
.1	95	3.2
.2	189	6.4
.3	284	9.6
.4	378	12.8
.5	473	16.0
.6	568	19.2
.7	662	22.4
.8	756	25.6
.9	852	28.8
1.0	946	32.0

Figure 13

Troubleshooting

The cause of an improperly functioning hydraulic system is best diagnosed with the use of proper testing equipment and a thorough understanding of the complete hydraulic system.

A hydraulic system with an excessive increase in heat or noise has a potential for failure. Should either of these conditions be noticed, immediately stop the machine, turn off the engine, locate the cause of the trouble, and correct it before allowing the machine to be used again.

Continued use of an improperly functioning hydraulic system could lead to extensive internal component damage.

The charts that follow contain information to assist in troubleshooting. There may possibly be more than one cause for a machine malfunction.

Refer to the Testing section of this Chapter for precautions and specific test procedures.

Problem	Possible Cause
Hydraulic oil leaks	Fitting(s), hose(s), or tube(s) are loose or damaged. O–ring(s) or seal(s) are missing or damaged.
Foaming hydraulic fluid	Oil level in reservoir is low. Hydraulic system has wrong kind of oil. One of the pump suction lines has an air leak.
Hydraulic system operates hot	Traction system pressure is high due to load or brakes applied. Oil level in reservoir is low, or inlet filter is loose or clogged. Oil is contaminated or too light. Oil cooler is damaged or plugged. By–pass relief is stuck open or air flow is obstructed. Charge pressure is low. Traction pump by–pass valve is open or defective. Wheel motor(s) or reel motor(s) are worn or damaged. Traction pump is worn or damaged.
Neutral is difficult to find or unit operates in one direction only	External control linkage is misadjusted, disconnected, binding, or damaged. Traction pump is worn or damaged.
Traction response is sluggish	Charge pressure is low. Hydraulic oil is very cold. Traction pump by–pass valve is open or worn. Brake is not released. Traction pump or wheel motor(s) are worn or damaged.

Problem	Possible Cause
No traction in either direction	Brake is not released. Oil level in reservoir is low. Traction pump by–pass valve is open. Charge pressure is low. Traction pump or wheel motor(s) are worn or damaged.
Wheel motor will not turn	Internal parts in wheel motor are damaged. Brakes are binding. Key on wheel motor shaft is sheared or missing.
Wheel motor will not hold load in neutral	Make up fluid from charge pump is not available. Flow control setting is wrong for reverse.
Noisy reel motor drive pump (cavitation)	Reservoir oil level is low. Suction line is restricted. Suction line has an air leak.
Reels will not turn	Cross–over relief valve(s) are stuck open (the other reels will still rotate). Valve S1 is stuck open. An electrical problem exists (See Chapter 5–Electrical System). Relief valve R1 is stuck open. LC1 logic valve is stuck open. Reel motor drive pump is damaged.
Reel speed is erratic	Reel to bedknife adjustment is too tight. Reel bearing(s) are damaged.
Reel motor case drain flow is excessive. Flow is greater than 0.7 GPM at 1200 PSI (2.6 LPM at 82.8 bar).	Excessive internal wear in reel motor exists. Reel bearing(s) are damaged.

Problem	Possible Cause
Cutting units will not lift or lift slowly	Engine speed is too low. Pump pulley drive belt is loose. Charge pump is damaged. Lift valve control linkage is binding or broken. Lift cylinder bushings are binding. Reservoir oil level is low. Inlet filter is loose or clogged. Charge pump pressure or flow is insufficient. Implement relief valve is stuck open. Lift control valve is damaged. Lift cylinders leak internally.
Cutting units raise, but will not stay up	Lift cylinders leak internally. Lift valve leaks.

Testing

The most effective method for isolating problems in the hydraulic system is by using hydraulic test equipment such as pressure gauges and flow meters in the circuits during various operational checks. (See Special Tools section in this Chapter.)

CAUTION

Failure to use gauges with recommended pressure (psi) rating as listed in test procedures could result in damage to gauge and possible personal injury from leaking hot oil.

Before Performing Hydraulic Tests

All obvious areas such as oil supply, filter, binding linkage, loose fasteners, or improper adjustments must be checked before assuming that a hydraulic component is the source of the problem being experienced.

Precautions For Hydraulic Testing

WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved by stopping the engine and lowering or supporting the cutting units or other implements.

Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Use paper or cardboard, not hands, to search for leaks. Hydraulic fluid escaping under pressure can have sufficient force to penetrate skin and cause serious injury. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury. Gangrene may result from such an injury.

1. Thoroughly clean the machine before disconnecting or disassembling any hydraulic components. Always keep in mind the need for cleanliness when working on hydraulic equipment. Contamination will cause excessive wear of hydraulic components.

2. Put caps or plugs on any hydraulic lines left open or exposed during testing or removal of components.

3. The engine must be in good operating condition. Use a tachometer when making a hydraulic test. Engine speed will affect the accuracy of the tester readings.

4. Because the hydraulic pump is belt driven, check for proper pump belt adjustment before performing any hydraulic test.

5. To prevent damage to tester or components, the inlet and the outlet hoses must be properly connected, and not reversed (when using tester with pressure and flow capabilities).

6. To minimize the possibility of damaging components, completely open load valve in hydraulic tester (when using tester with pressure and flow capabilities).

7. Install fittings finger tight, far enough to insure that they are not cross–threaded, before tightening with a wrench.

8. Position the tester hoses so that rotating machine parts will not make contact with them and result in hose or tester damage.

9. Check and adjust the oil level in the reservoir after connecting hydraulic test equipment.

10. Check the control linkage for improper adjustment, binding, or broken parts.

11. All hydraulic tests should be made with the hydraulic oil at normal operating temperature.

TEST NO. 1: Traction Circuit Working Pressure (Using Pressure Gauge)

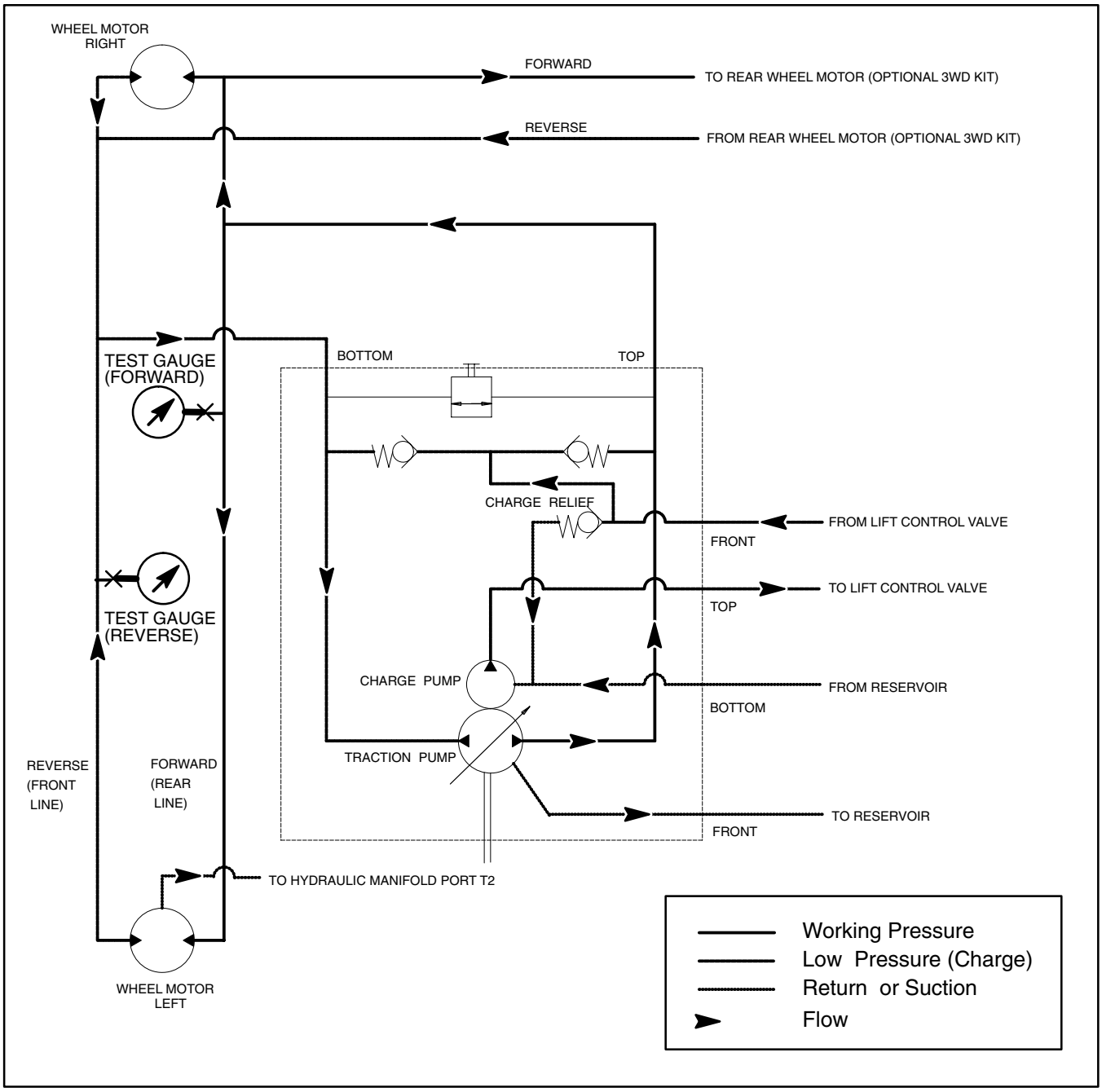


Figure 14

Procedure for <u>Traction Circuit Working Pressure</u> Test:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes.

2. Park machine on a level surface with the cutting units lowered and off. Make sure engine is off.

3. Read Precautions For Hydraulic Testing.

4. Make sure that traction pedal is adjusted to the neutral position (see Traction Unit Operator's Manual).

5. Connect pressure test gauge with a hydraulic hose attached to the forward test port located on the hydraulic tube (Fig. 15 and 16). Make sure gauge hose is long enough so the operator can read gauge while driving the machine.

6. Start engine and move throttle to full speed **(3200 ± 50 RPM)**.

7. Drive machine in the **forward** direction. Observe test gauge.

   A. Pressure while transporting the machine over a flat, level surface should be about **500 PSI**.

   B. Pressure while mowing should range between **1000 to 2000 PSI** and will vary with terrain.

8. Release traction pedal and turn off machine.

9. Disconnect test gauge and hose from the test port (Fig. 16).

10. If specification is not met, the hydrostat needs to be repaired or replaced as necessary.

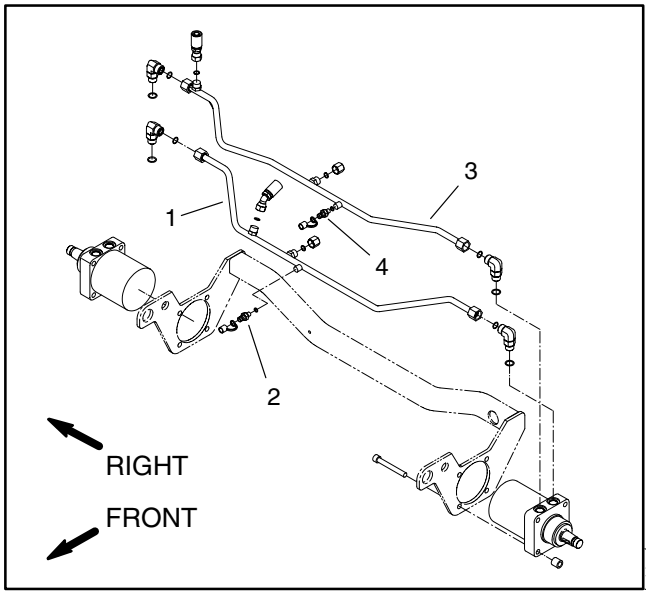


Figure 15

1. Hydraulic tube (forward)
2. Forward test port
3. Hydraulic tube (reverse)
4. Reverse test port

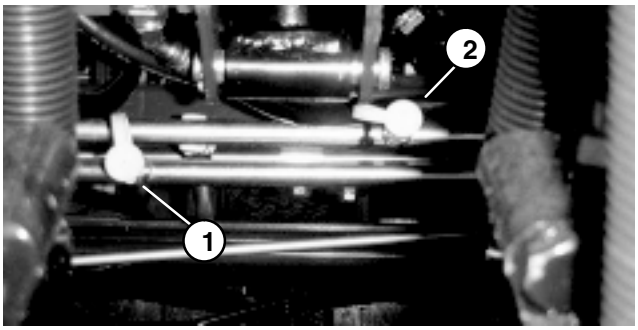


Figure 16

1. Forward test port
2. Reverse test port

TEST NO. 2: Mow Circuit Working Pressure (Using Pressure Gauge)

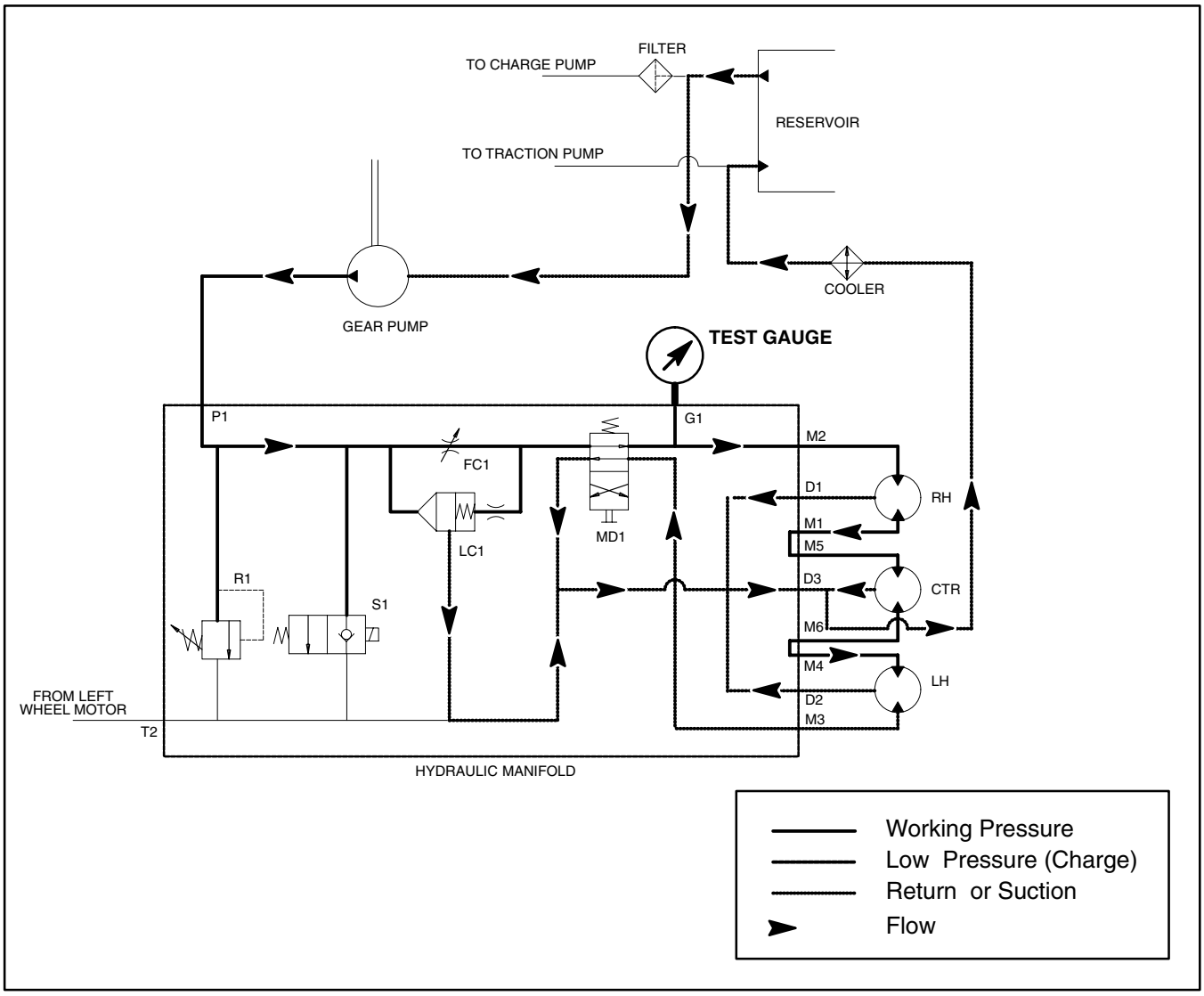


Figure 17

Procedure for Mow Circuit Working Pressure Test:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes.

2. Park machine on a level surface with the cutting units lowered and off. Make sure engine is off.

3. Read Precautions For Hydraulic Testing.

4. Connect pressure test gauge with a hydraulic hose attached to the reel circuit test port on the hydraulic manifold (Fig. 18). Make sure gauge hose is long enough so the operator can read gauge while driving the machine.

5. Make sure backlap knob on the hydraulic manifold is in the **mow** position. Adjust reel speed knob for typical mowing conditions.

CAUTION

Keep away from reels during test to prevent personal injury from the rotating reel blades.

6. Start engine and move throttle to full speed **(3200 ± 50 RPM)**. Engage the cutting units.

7. Watch pressure gauge carefully while mowing with the machine.

8. Reel circuit pressure should be about **600 PSI**.

9. Disengage cutting units. Shut off engine.

10. Disconnect test gauge with hose from manifold test port.

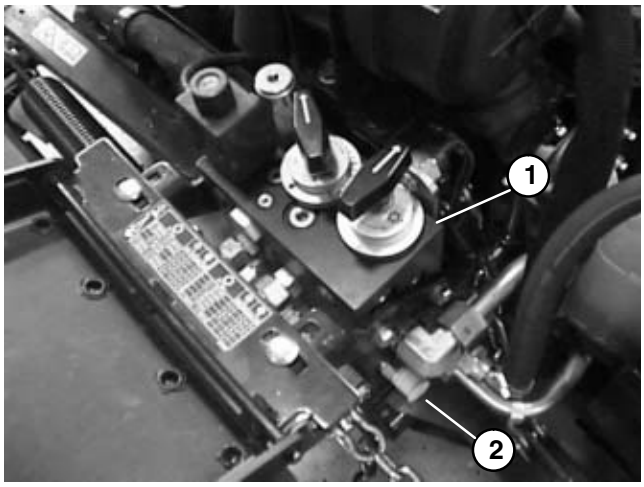


Figure 18

1. **Hydraulic manifold**
2. **Test port**

TEST NO. 3: Traction Pump Flow (Using Tester With Pressure Gauges and Flow Meter)

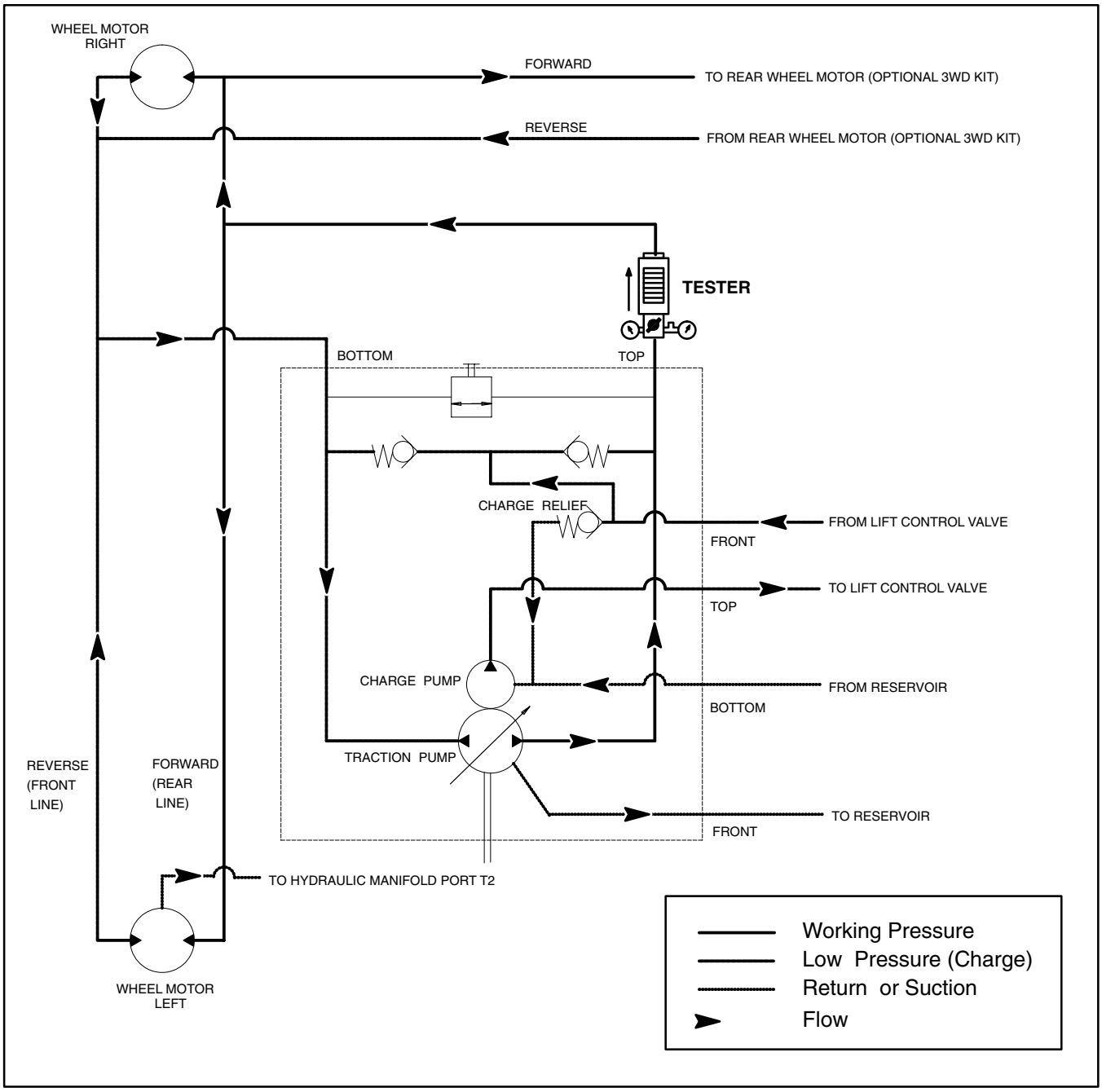


Figure 19

Procedure for Traction Pump Flow Test:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes.

2. Park machine on a level surface with the cutting units lowered and off. Make sure engine is off.

3. Read Precautions For Hydraulic Testing.

4. Make sure that traction pedal is adjusted to the neutral position (see Traction Unit Operator's Manual).

5. Make sure that pump drive belt is adjusted properly. (see Traction Unit Operator's Manual).

6. Block one front traction wheel off the floor to allow flow through the traction circuit.

7. Chock remaining wheels to prevent movement of the machine.

8. Attach a heavy chain to the rear of the machine frame and something immovable in the shop.

9. Make sure parking brake is off.

CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.

10. Clean hose fitting and disconnect hose from the elbow connection on the top of the traction pump (Fig. 20).

IMPORTANT: Make sure oil flow indicator arrow on the flow gauge is showing that the oil will flow from the motor through the tester and into the hose.

11. Install flow tester with pressure gauges in series with the motor and the disconnected hose. Make sure flow control valve is fully open.

12. One person should sit on the seat and operate the machine while another person reads the tester. Start engine.

13. Adjust engine speed so pump speed is **2400 RPM** (engine speed approximately 2700 RPM). Verify pump speed with a phototac.

CAUTION

Use extreme caution when taking gauge readings. The front tire on the ground will be trying to move the machine forward.

14. Slowly push traction pedal to fully forward position.

15. Close flow control valve until pressure gauge reads **1000 PSI**. Observe flow gauge.

TESTER READING: flow approximately **13 GPM**

16. Release traction pedal and turn off machine.

17. Disconnect tester from elbow connection and hose. Reconnect hose to elbow connection.

NOTE: If pressure is good under no load, but drops below specification when under traction load, the piston pump and/or wheel motor(s) should be suspected of wear. When a pump and/or motor is worn or damaged, the charge pump is not able to keep up with internal leakage in the traction circuit (See Test #3).

18. If specifications are not met, the traction pump needs to be repaired or replaced as necessary.

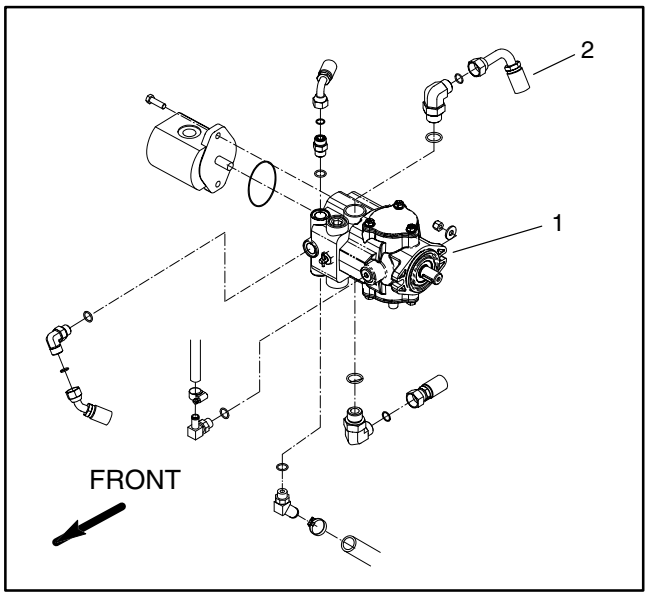


Figure 20

1. **Traction pump**
2. **Hose to traction forward**

TEST NO. 4: Charge Pump Flow and Lift Relief Pressure (Using Tester With Pressure Gauges and Flow Meter)

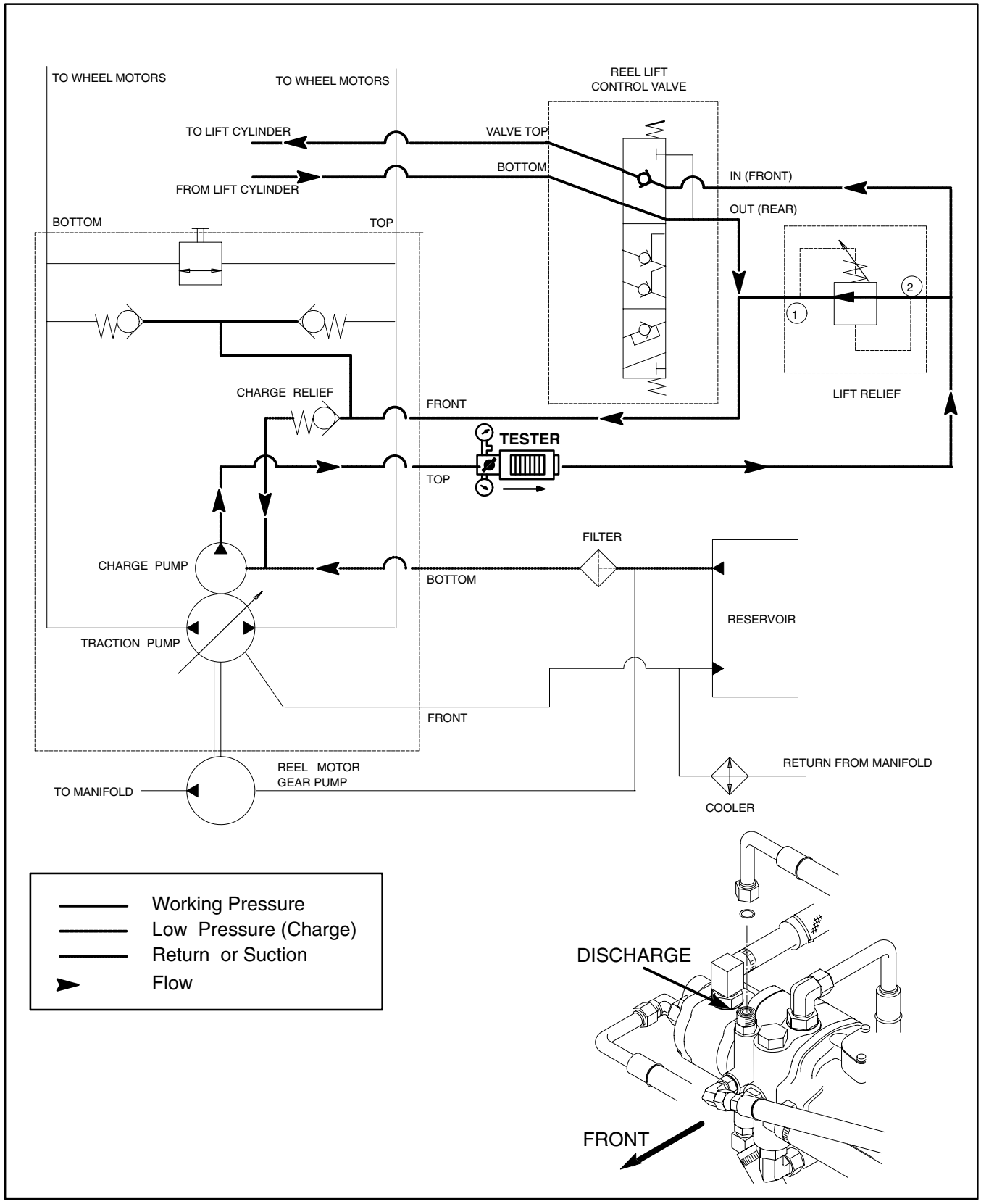


Figure 21

Procedure for Charge Pump Flow Test:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes.

2. Park machine on a level surface with the cutting units lowered. Make sure engine is off and the parking brake is engaged.

3. Read Precautions For Hydraulic Testing.

CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.

4. Disconnect outside top hose from the discharge fitting of the charge pump (Fig. 21). Connect gauge end of flow tester with pressure gauges to the pump discharge fitting.

5. Connect the other end of the tester to the disconnected hose.

CAUTION

Make sure that all hoses are free of the flywheel after tester installation.

6. Make sure that traction pedal and lift valve are in neutral and the parking brake is engaged.

7. Start and operate engine at full speed **(3200 ± 50 RPM)**.

8. Watch flow and pressure gauges carefully while slowly closing the flow control valve until pressure gauge reads **500 PSI**.

9. **Minimum** flow gauge reading should be **2.5 GPM**. If specification is not met, repair or replace charge pump.

Procedure for Lift Relief Pressure Check:

CAUTION

Do not allow charge pressure to exceed 650 PSI.

1. Fully open control valve on the tester.

2. Make sure hydraulic oil is at operating temperature.

3. Operate engine at full speed **(3200 ± 50 RPM)**.

4. Watch pressure gauge carefully. Make sure lift lever is in the neutral position. Record the pressure.

5. While holding the lift lever in the raised position, watch the pressure gauge. Record pressure when the relief valve opens.

6. Return lift lever to neutral position. Shut off engine.

7. Subtract the relief valve closed pressure from the relief valve open pressure (see example below). The difference should be from **450 to 500 PSI**.

   A. If this specification is not met, adjust lift relief valve.

   B. If this specification is met, go to step 9.

Example Calculation	PRESSURE
Relief Valve Open (Lever raised)	620
Relief Valve Closed (Lever in neutral)	150
Open less Closed Pressure **(450 to 500 PSI)**	470

NOTE: Do not remove lift relief valve from the hydraulic manifold for adjustment.

8. Adjust the lift relief valve pressure as follows:

   A. Remove the cap from the relief valve.

   B. To increase the relief valve pressure setting, use an allen wrench and turn adjustment socket clockwise. A 1/8 turn on the socket will make a measurable change in relief pressure.

   C. To decrease the relief valve pressure setting, use an allen wrench and turn adjustment socket counterclockwise. A 1/8 turn on the socket will make a measurable change in relief pressure.

   D. Repeat steps 1 through 8 above until the relief valve pressure setting is correct. Reinstall cap on relief valve when valve is set properly.

   E. If the relief valve pressure setting can not be adjusted to specification, go to step 9 and replace the relief valve.

NOTE: If the pressure and flow are within specification but the cutting units do not lift or lift slowly, check for mechanical binding or internal leakage of the lift cylinder.

9. Disconnect tester from the pump and hose. Reconnect hose to the pump.

TEST NO. 5: Charge Pump Relief Pressure (Using Pressure Gauge)

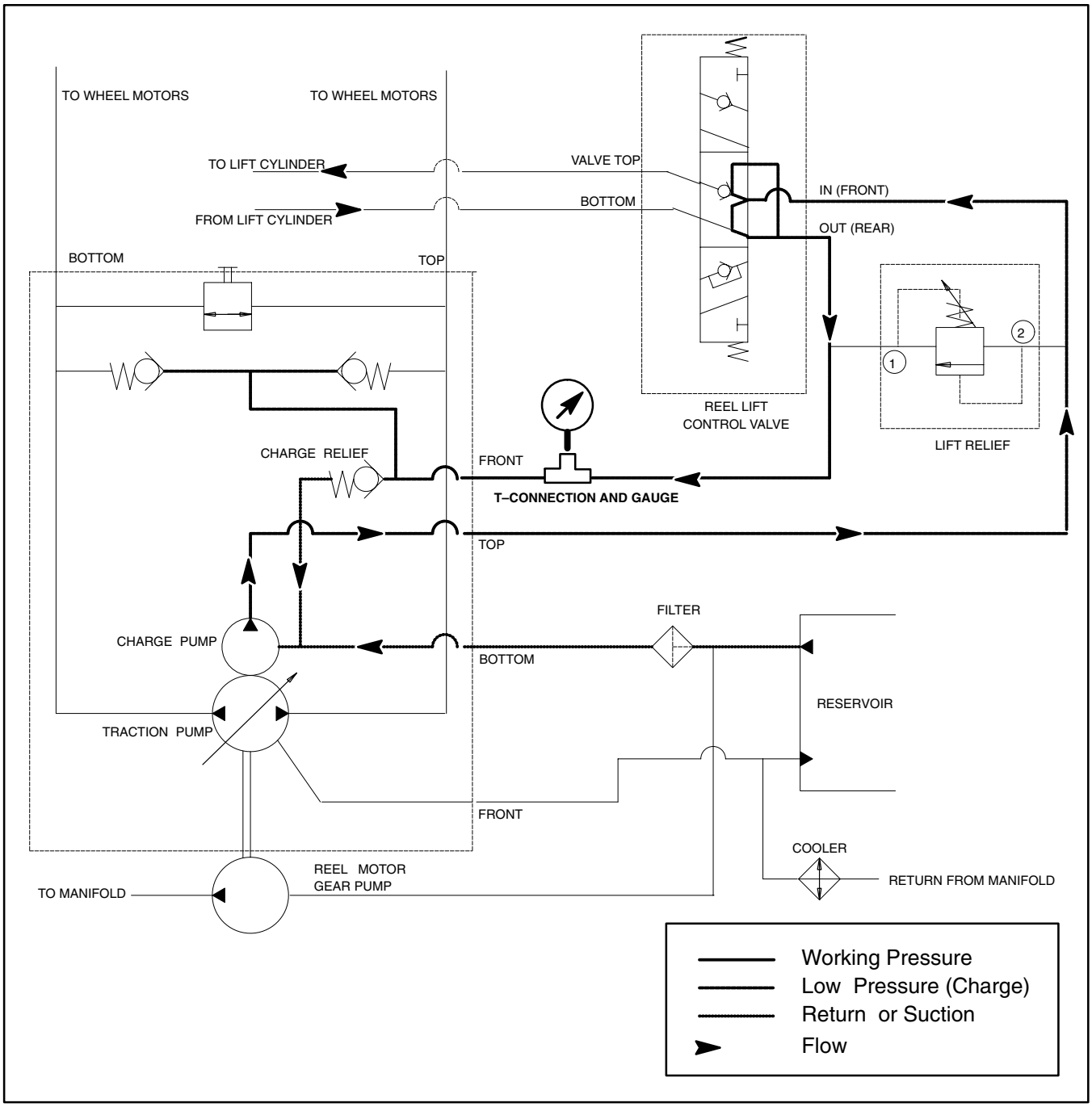


Figure 22

Procedure for Charge Pump Relief Pressure Test:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes.

2. Park machine on a level surface with the cutting units lowered. Make sure engine is off and the parking brake is engaged.

3. Read Precautions For Hydraulic Testing.

CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.

4. Disconnect hose from the front fitting of the charge pump returning from the control valve (Fig. 23). Connect T–connector and pressure gauge to the pump and hose fitting.

CAUTION

Make sure that all hoses are free of the flywheel after installation.

5. Make sure that traction pedal and lift valve are in neutral and the parking brake is engaged.

6. Operate engine at full speed (**3200 ± 50 RPM**).

7. Pressure gauge should read from **100** to **150 PSI**. If specification is not met, inspect charge relief valve in traction pump.

8. A dynamic charge pressure test can be performed as follows:

   A. With T–connector and pressure gauge still connected, sit in the operator seat and press the traction pedal to forward.

   B. While machine is moving, monitor the charge pressure reading on the pressure gauge (do not activate the lift control while monitoring charge pressure).

   C. The charge pressure should drop no more than 15% from initial test reading (Step 7 above). A pressure drop of more than 15% indicates a traction circuit leak (e.g. a worn or damaged piston pump and/or wheel motor).

9. Shut off engine.

10. Disconnect gauge and T–connection from the pump and hose. Reconnect hose to the pump.

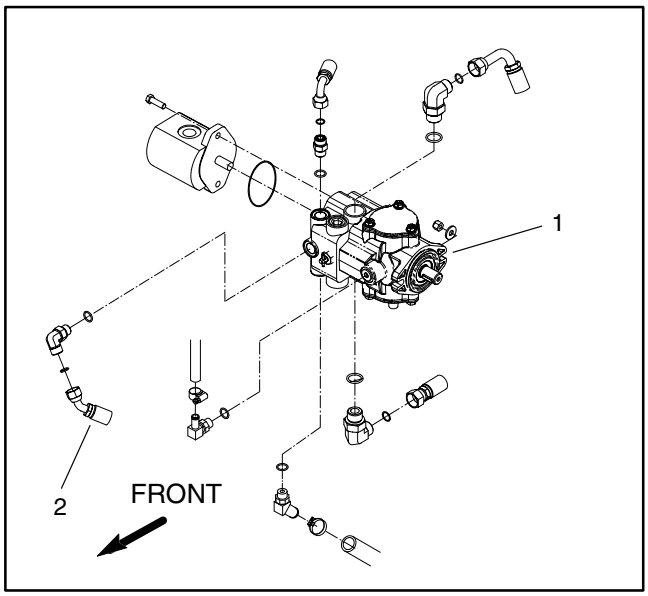


Figure 23

1. **Traction pump**
2. **Hose from lift control**

TEST NO. 6: Reel Gear Pump Flow (Using Tester With Pressure Gauges and Flow Meter)

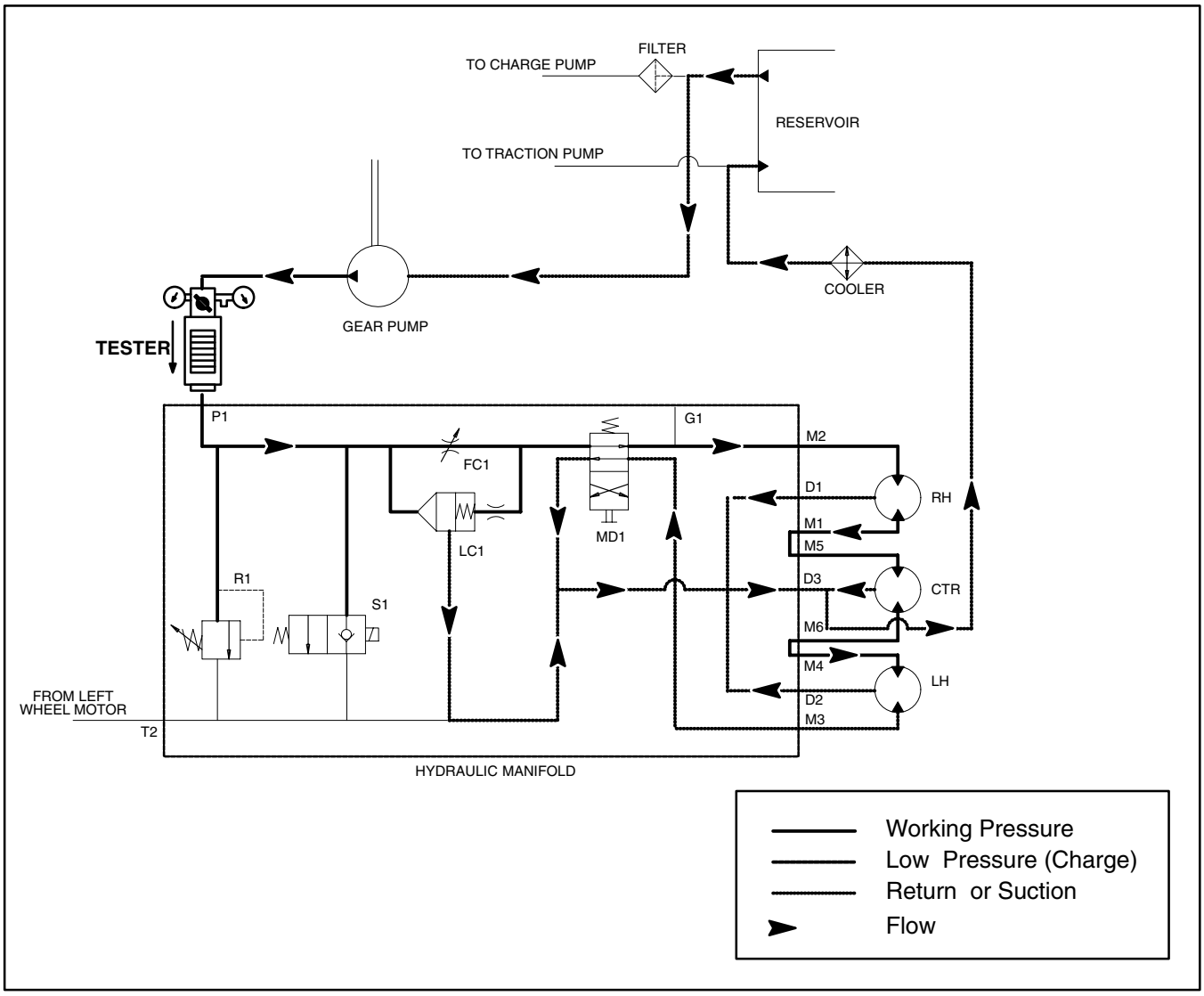


Figure 24

Procedure for Reel Gear Pump Flow Test:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes.

2. Park machine on a level surface with the cutting units lowered. Make sure engine is off and the parking brake is engaged.

3. Read Precautions For Hydraulic Testing.

CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.

4. Clean hose connection and reel gear pump. Disconnect hose connection on the reel gear pump leading to port P1 on the hydraulic manifold (Fig. 25).

IMPORTANT: Make sure oil flow indicator arrow on the flow gauge is showing that the oil will flow from the pump through the tester and into the valve block.

5. Install flow tester with pressure gauges in series with reel gear pump and the disconnected hose leading to port P1 of the hydraulic manifold. Make sure the flow control valve on the tester is fully open.

6. Make sure backlap knob on the valve block is in the **mow** position.

7. Start engine and move throttle to full speed (**3200 ± 50 RPM**). **Do not engage the cutting units**.

8. Watch pressure gauge carefully while slowly closing the flow control valve until **1500 PSI** is obtained. Verify with a phototac that the pump speed is **2825 RPM**.

9. Flow indication should be approximately **5.9 GPM**.

10. Shut off engine.

11. Disconnect tester from manifold and hose. Reconnect hose to the pump.

12. If flow was less than **5.9 GPM** or a pressure of **1500 PSI** cannot be obtained, check for restriction in the pump suction hose. If suction hose is not restricted, remove reel gear pump and repair or replace as necessary.

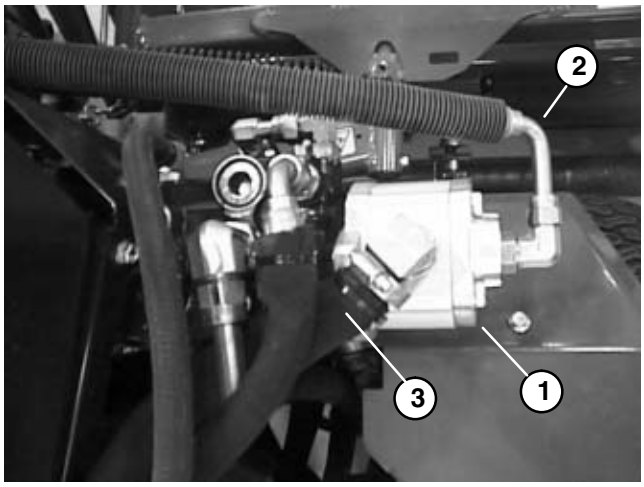


Figure 25

1. **Reel gear pump**
2. **Hose to manifold P1**
3. **Suction hose**

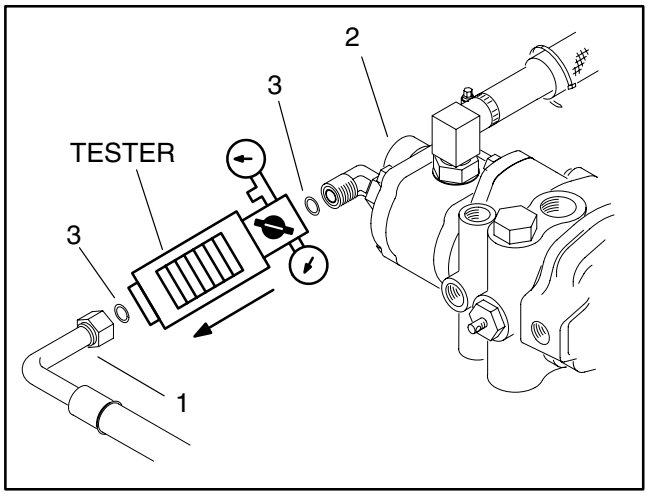


Figure 26

1. **Disconnected hose**
2. **Reel gear pump**
3. **O–ring**

TEST NO. 7: Manifold Relief Valve Pressure (Using Tester With Pressure Gauges and Flow Meter)

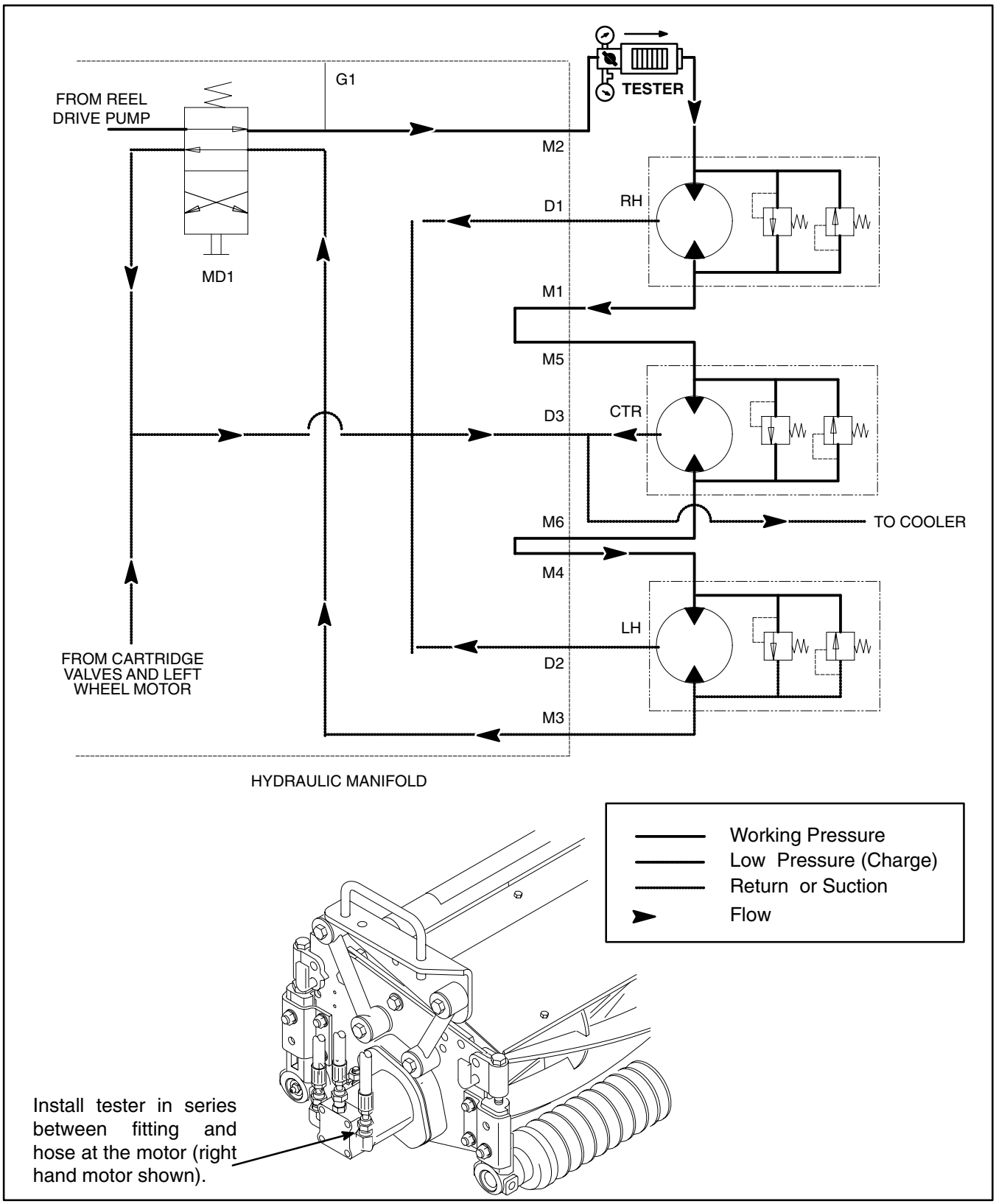


Figure 27

Procedure for Manifold Relief Valve Pressure Test:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes.

2. Park machine on a level surface with the cutting units lowered. Make sure engine is off and the parking brake is engaged.

3. Read Precautions For Hydraulic Testing.

CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.

4. Clean hose connections of right hand reel motor. Disconnect the hose leading from the right hand reel motor to port M2 on the hydraulic manifold.

IMPORTANT: Make sure oil flow indicator arrow on the flow gauge is showing that the oil will flow from the hose through the tester and into the motor.

5. Install flow tester with pressure gauges in series with the hose and motor. Make sure the flow control valve on the tester is fully open.

6. Make sure backlap knob on the valve block is in the **mow** position. Make sure reel speed knob is set to position 9 or greater.

CAUTION

Keep away from reels during test to prevent personal injury from the rotating reel blades.

7. Start engine and move throttle to full speed (**3200 ± 50 RPM**). Engage the cutting units.

8. Watch pressure gauge carefully while slowly closing the flow control valve until the manifold relief opens.

9. System pressure should be from **2700** to **3300 PSI** as the relief valve opens.

   A. If specification is not met, adjust relief valve (step 10).

   B. If this specification is met, go to step 11.

NOTE: Do not remove relief valve from the hydraulic manifold for adjustment.

10. Adjust the relief valve pressure as follows:

    A. Remove the cap from the relief valve (Fig. 28).

    B. To increase the relief valve pressure setting, use an allen wrench and turn adjustment socket slightly clockwise. A 1/8 turn on the socket will make a measurable change in relief pressure.

    C. To decrease the relief valve pressure setting, use an allen wrench and turn adjustment socket slightly counterclockwise. A 1/8 turn on the socket will make a measurable change in relief pressure.

    D. Repeat steps 1 through 10 above until the relief valve pressure setting is correct. Reinstall cap on relief valve when valve is set properly.

    E. If the relief valve pressure set point cannot be adjusted to specification, go to step 11 and replace the relief valve.

11. Disengage cutting units. Shut off engine.

12. Disconnect tester from manifold and hose. Reconnect hose to the pump.

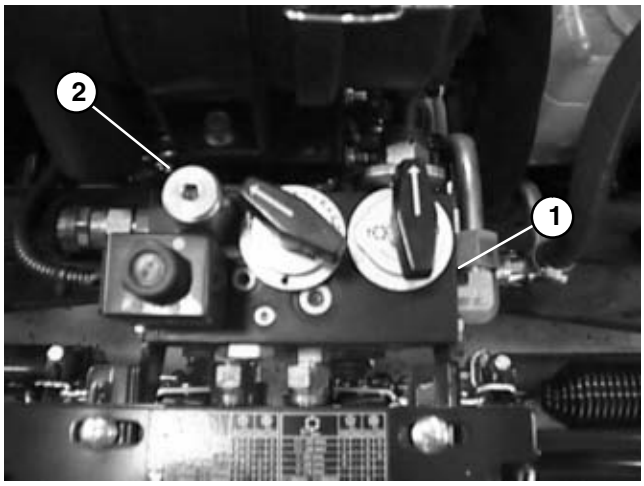


Figure 28

1. **Reel drive hydraulic manifold**
2. **Reel relief valve**

TEST NO. 8: Cross–over Relief Pressures (Using Pressure Gauge)

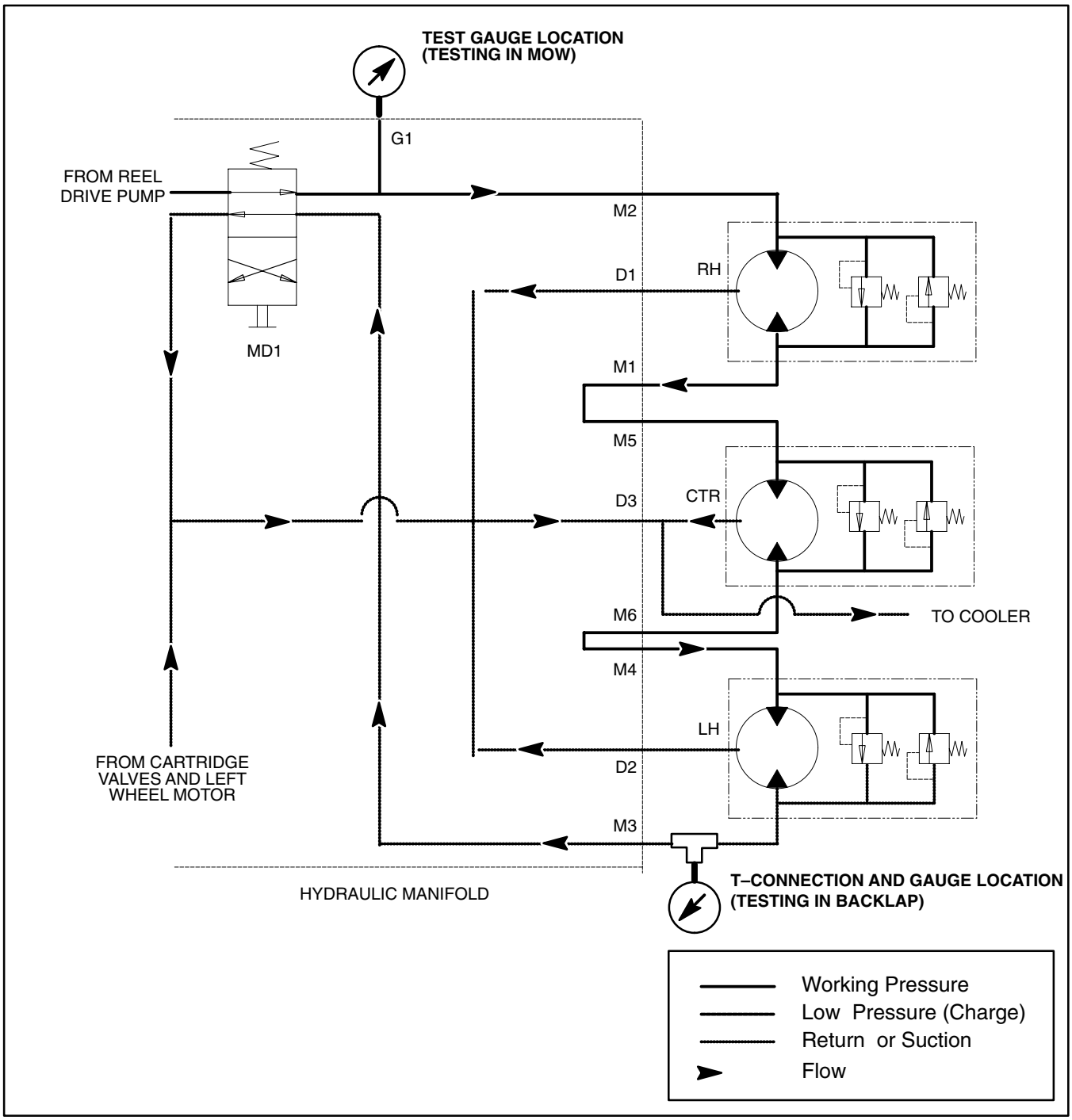


Figure 29

NOTE: One way to find a possibly bad reel motor is to have another person observe the machine while mowing in dense turf. A bad motor will run slower, produce fewer clippings, and may cause marcelling (or a washboard appearance) on the turf.

Procedure for Cross–over Relief Pressures Test:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes. Make sure the hydraulic tank is full.

2. Park machine on a level surface with the cutting units lowered. Make sure engine is off and parking brake is engaged. Back bedknives off all reels.

CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.

3. Clean manifold port G1. Remove cap and install pressure gauge in manifold port G1.

4. Put a block of wood between the blades of the cutting unit being tested to prevent that reel from rotating.

5. Make sure backlap knob on the valve block is in the **mow** position.

6. One person should sit on the seat and operate the machine while another person reads the tester. Start engine and set throttle to full speed (**3200 ± 50 RPM**).

CAUTION

Keep away from reels during test to prevent personal injury from the rotating reel blades.

CAUTION

Do not allow system pressure to exceed 1700 PSI. Shut off unit to prevent an over pressure condition.

7. Engage cutting units. Observe pressure gauge.

Motor Position	Pressure Range (PSI)
Right Hand	1500 to 1600
Rear	1540 to 1640
Left Hand	1580 to 1680

8. Disengage cutting units and stop engine. If specifications are not met, replace cross–over relief. If specifications are met, remove block of wood from cutting unit and repeat test on other reels in mow direction.

9. Remove test gauge and put cap on manifold port G1.

IMPORTANT: Each reel motor has two cross–over reliefs. Test reliefs in the backlap direction only if they are expected to be a problem. After testing cross–over reliefs in the backlap direction, make sure the reel motor couplings are torqued (see Hydraulic Reel Motor in the Service and Repair section of Chapter 7 – Cutting Units).

10. If cross–over relief pressure is to be tested in the backlap direction, clean left–hand reel motor and its hose connection leading to manifold port M3. Disconnect hose connection and install pressure gauge with a T–connection between the hose connection and the reel motor.

11. Put a block of wood between the blades of the cutting unit being tested to prevent that reel from rotating.

12. Make sure backlap knob on the valve block is in the **backlap** position.

13. One person should sit on the seat and operate the machine while another person reads the gauge. Start engine and move the throttle to full speed (**3200 ± 50 RPM**).

CAUTION

Keep away from reels during test to prevent personal injury from the rotating reel blades.

CAUTION

Do not allow system pressure to exceed 1700 PSI. Shut off unit to prevent an over pressure condition.

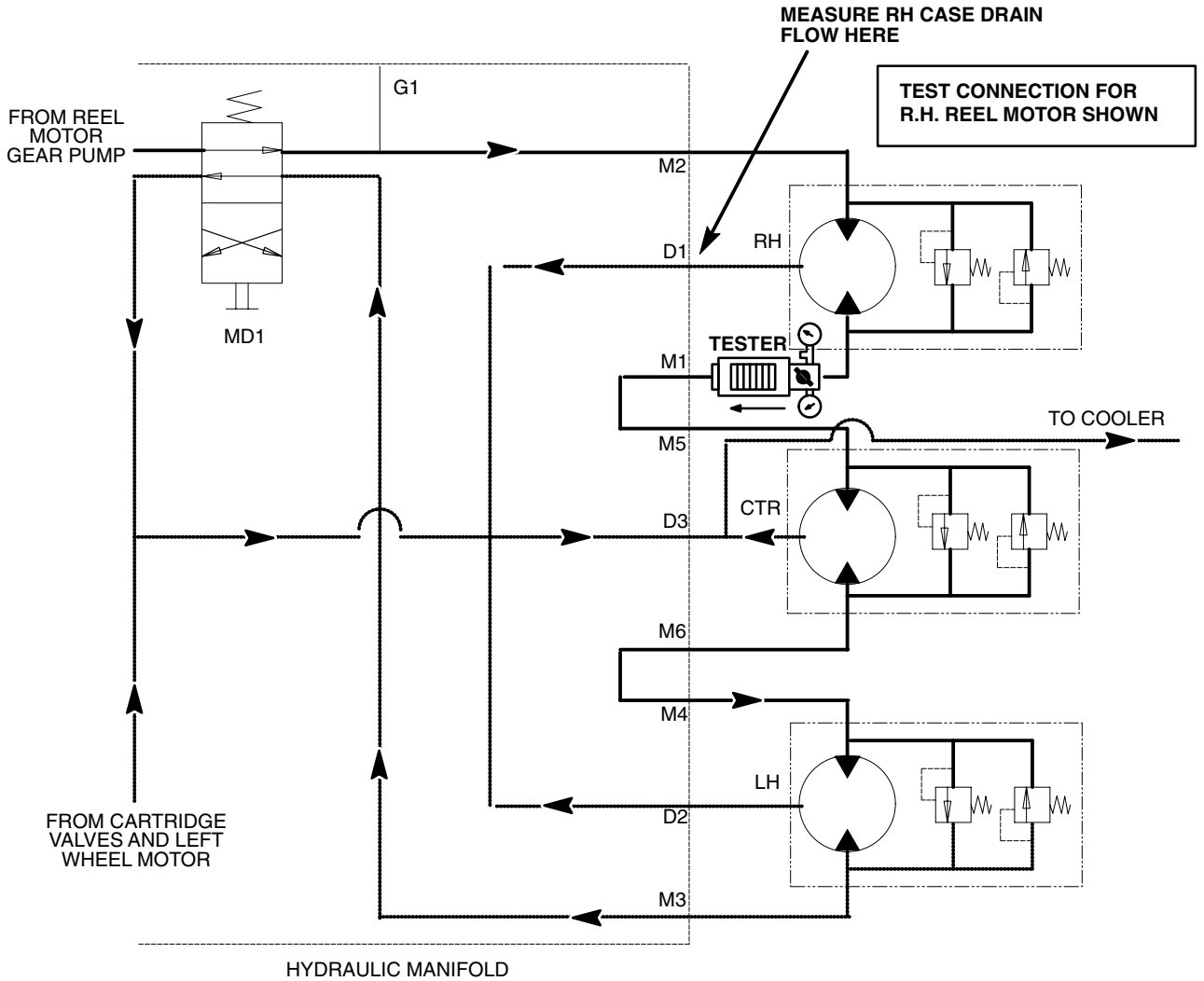
14. Engage cutting units. Observe pressure gauge.

Motor Position	Pressure Range (PSI)
Right Hand	1580 to 1680
Rear	1540 to 1640
Left Hand	1500 to 1600

15. Disengage cutting units and stop engine. If specifications are not met, the cross–over relief needs replacing. Remove block of wood from cutting unit and repeat test on other reels in the backlap direction.

16. Remove test gauge and reconnect hose to motor. Adjust bedknife to reel clearance on all cutting units (see Cutting Unit Operator's Manual).

TEST NO. 9: Reel Motor Case Drain (Using Tester With Pressure Gauges and Flow Meter)



GPM	Milliliters in 15 sec.	Ounces in 15 sec.
.1	95	3.2
.2	189	6.4
.3	284	9.6
.4	378	12.8
.5	473	16.0
.6	568	19.2
.7	662	22.4
.8	756	25.6
.9	852	28.8
1.0	946	32.0

Figure 30

Procedure for Reel Motor Case Drain Test:

NOTE: Over a period of time, a reel motor can wear internally. A worn motor may by–pass oil to its case drain causing the motor to be less efficient. Eventually, enough oil loss will cause the reel motor to stall under heavy cutting conditions. Continued operation with a worn, inefficient motor can generate excessive heat, cause damage to seals and other components in the hydraulic system, and affect quality of cut.

NOTE: One way to find a possibly bad reel motor is to have another person observe the machine while mowing in dense turf. A bad motor will run slower, produce fewer clippings, and may cause marcelling (or a washboard appearance) on the turf.

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes. Make sure the hydraulic tank is full.

2. Park machine on a level surface with the cutting units lowered. Make sure engine is off and the parking brake is engaged.

3. Read Precautions For Hydraulic Testing.

CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.

Motor Position	Manifold Port (Case Drain)	Manifold Port (Motor Return)
Right Hand	D1	M1
Left Hand	D2	M3
Rear	D3	M6

4. On the suspected bad reel motor, clean hose connection and disconnect return hose from motor to manifold (see table).

IMPORTANT: Make sure oil flow indicator arrow on the flow gauge is showing that the oil will flow from the motor through the tester and into the hose.

5. Install flow tester with pressure gauges in series with the motor and the disconnected return hose. Make sure the flow control valve on the tester is fully open.

6. Make sure backlap knob on the valve block is in the **mow** position.

7. Clean hose fitting and disconnect case drain hose from the manifold block (see table). Plug the manifold port.

CAUTION

Keep away from reels during test to prevent personal injury from the rotating reel blades.

8. One person should sit on the seat and operate the machine while another person holds the hose and reads the tester. Start engine and move the throttle to full speed (**3200 ± 50 RPM**).

9. Engage cutting units by pulling the reel engage knob on the instrument panel **out**. While watching pressure gauges, slowly close flow control valve until a pressure of **1200 PSI** is obtained.

10. Collect hydraulic fluid for **15** seconds by putting case drain hose into 1 quart container graduated in ounces (1 liter container graduated in milliliters).

11. After **15** seconds, push knob on the instrument panel **in** to disengage cutting units. Stop the engine.

12. Measure the amount of oil collected in the container. Divide the number of ounces collected by **32** to get gallons per minute. (divide the number of milliliters collected by **250** to get liters per minute). See chart in Figure 30.

13. If flow was greater than **0.7 GPM** (**2.6 LPM**), repair or replace the reel motor as necessary.

14. Disconnect tester from motor and hose. Reconnect hose to the motor.

15. Remove cap from manifold port. Reconnect case drain hose to the manifold block.

TEST NO. 10: Wheel Motor Case Drain (Using Tester With Pressure Gauges and Flow Meter)

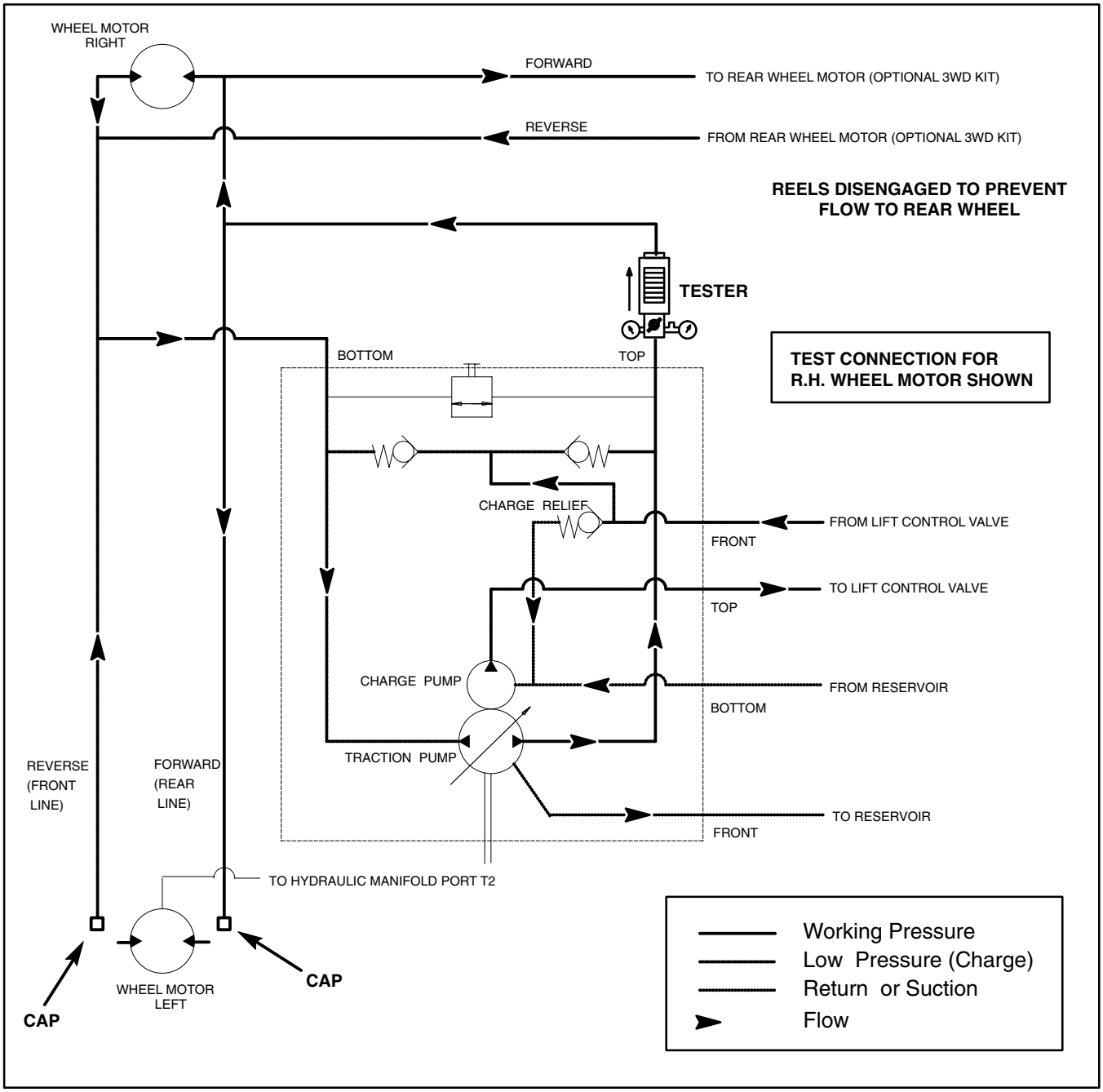


Figure 31

NOTE: Over a period of time, a wheel motor can wear internally. A worn motor may by–pass oil to its case drain causing the motor to be less efficient. Eventually, enough oil loss will cause the wheel motor to stall under heavy load conditions. Continued operation with a worn, inefficient motor can generate excessive heat, cause damage to seals and other components in the hydraulic system, and affect overall machine performance.

Procedure for Wheel Motor Case Drain Test:

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes. Make sure the hydraulic tank is full.

2. Park machine on a level surface with the cutting units lowered and off. Make sure engine is off and the parking brake is engaged.

3. Read Precautions For Hydraulic Testing.

4. Make sure that traction pedal is adjusted to the neutral position (see Traction Unit Operator's Manual).

5. Attach a heavy chain between the rear of the machine frame and an immovable object to prevent the machine from moving during testing.

6. Chock front wheel being tested to prevent rotation of the wheel. Make sure parking brake is on.

7. Disconnect hydraulic lines from front wheel motor that is **not** being tested. Cap disconnected hydraulic lines and plug ports in wheel motor to prevent contamination.

8. Clean hose fitting and disconnect hose from the elbow connection on the top of the traction pump (Fig. 20).

IMPORTANT: Make sure oil flow indicator arrow on the flow gauge is showing that the oil will flow from the motor through the tester and into the hose.

9. Install flow tester with pressure gauges in series with the pump and the disconnected hose. Make sure flow control valve is fully open.

10. If machine has 3WD kit installed, make certain that reel engage switch is pushed in (disengaged) to prevent hydraulic flow to the rear wheel.

11. Start engine and move throttle to full speed **(3200 ± 50 RPM)**.

CAUTION

Use extreme caution when performing test. The front tire on the ground will be trying to move the machine forward.

12. Slowly push traction pedal in **forward** direction until 1000 PSI is displayed on the pressure gauge.

13. Wheel motor internal leakage will be shown on flow meter in GPM. Flow should be **less than 1.5 GPM** for the tested wheel motor.

14. If specifications are not met, the tested wheel motor needs to be repaired or replaced as necessary.

15. If remaining front wheel motor requires testing, complete steps 6 to 13 for the remaining motor.

16. If machine has 3WD kit installed and rear wheel motor requires testing:

A. Both front wheel motors should have hydraulic lines disconnected. Cap disconnected hoses and plug ports in wheel motor to prevent contamination.

B. Attach a heavy chain between the rear of the machine frame and an immovable object to prevent the machine from moving during testing.

C. Chock rear wheel to prevent it from turning.

D. Clean hose fitting and disconnect hose from the elbow connection on the top of the traction pump (Fig. 20).

E. Install tester in series with the pump and the disconnected hose. Make sure flow control valve is fully open.

F. Start engine and move throttle to full speed **(3200 ± 50 RPM)**.

CAUTION

Use extreme caution when performing test. The rear tire on the ground will be trying to move the machine forward.

G. Slowly push traction pedal in **forward** direction until 1000 PSI is displayed on the pressure gauge.

H. Wheel motor internal leakage will be shown on flow meter in GPM. Flow should be **less than 1.5 GPM** for the tested wheel motor.

I. If specifications are not met, the wheel motor needs to be repaired or replaced.

17. Disconnect tester from hydraulic fitting and hose. Reconnect hose to pump connection.

18. Reconnect hydraulic lines to wheel motors.

General Precautions for Removing and Installing Hydraulic System Components

Before Repair or Replacement of Components

1. Before removing any parts from the hydraulic system, park machine on a level surface, engage parking brake, lower cutting units or attachments, and stop engine. Remove key from the ignition switch.

2. Clean machine before disconnecting, removing, or disassembling any hydraulic components. Make sure hydraulic components, hoses connections, and fittings are cleaned thoroughly. Always keep in mind the need for cleanliness when working on hydraulic equipment.

CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. Controls must be operated with the ignition switch in RUN and the engine OFF. Make sure all electrically operated control valves are actuated. Return ignition switch to OFF when pressure has been relieved. Remove key from the ignition switch.

3. Put caps or plugs on any hydraulic lines, hydraulic fittings, and components left open or exposed to prevent contamination.

4. Put labels on disconnected hydraulic lines and hoses for proper installation after repairs are completed.

5. Note the position of hydraulic fittings (especially elbow fittings) on hydraulic components before removal. Mark parts if necessary to make sure they will be aligned properly when reinstalling hydraulic hoses and tubes.

After Repair or Replacement of Components

1. Check oil level in the hydraulic reservoir and add correct oil if necessary. Drain and refill hydraulic system reservoir, and change oil filter if component failure was severe or system is contaminated (see Flush Hydraulic System).

2. Lubricate O–rings and seals with clean hydraulic oil before installing hydraulic components.

3. Make sure caps or plugs are removed from the hydraulic tubes, hydraulic fittings, and components before reconnecting.

4. Use proper tightening methods when installing hydraulic hoses and fittings (see Hydraulic Fitting Installation).

5. After repairs, check control linkages and cables for proper adjustment, binding, or broken parts.

6. After disconnecting or replacing any hydraulic components, operate machine functions slowly until air is out of system (see Hydraulic System Start Up).

7. Check for hydraulic oil leaks. Shut off engine and correct leaks if necessary. Check oil level in hydraulic reservoir and add correct oil if necessary.

Check Hydraulic Lines and Hoses

WARNING

Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Use paper or cardboard, not hands, to search for leaks. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury. Gangrene may result from such an injury.

Check hydraulic lines and hoses daily for leaks, kinked lines, loose mounting supports, wear, loose fittings, weather deterioration and chemical deterioration. Make all necessary repairs before operating.

Flush Hydraulic System

IMPORTANT: Flush the hydraulic system any time there is a severe component failure or the system is contaminated (oil appears milky or black or contains metal particles).

IMPORTANT: Flush hydraulic system when changing from petroleum base hydraulic fluid, such as Mobil DTE 15M, to biodegradable fluid, such as Mobil EAL 224H. Operate machine under normal operating conditions for at least four (4) hours before draining.

1. Park machine on a level surface. Lower cutting units, stop engine, engage parking brake, and remove key from ignition switch.

2. Clean area around filter mounting area. Remove filter and drain reservoir into a suitable container. Drain hydraulic system. Drain all hoses, tubes, and components while the system is warm. Discard filter.

3. Inspect and clean reservoir (see Inspecting Reservoir Parts).

4. Make sure filter mounting surface is clean. Apply hydraulic oil to gasket on the new filter. Screw filter on until gasket contacts mounting plate, then tighten filter half a turn.

NOTE: Use biodegradable fluid, such as Mobil EAL 224H, for this step if you are changing to this type of fluid. Use only hydraulic fluids specified in Traction Unit Operator's Manual. Other fluids could cause system damage.

5. Fill hydraulic reservoir.

6. Disconnect electrical connector to the fuel stop solenoid to prevent engine from starting.

7. Turn ignition key switch to start; engage starter for ten (10) seconds to prime hydraulic pump. Repeat this step again.

8. Attach electrical connector to the fuel stop solenoid.

9. Start engine and let it idle at low speed for a minimum of two (2) minutes.

10. Increase engine speed to high idle for minimum of one (1) minute under no load.

11. Raise and lower cutting units several times.

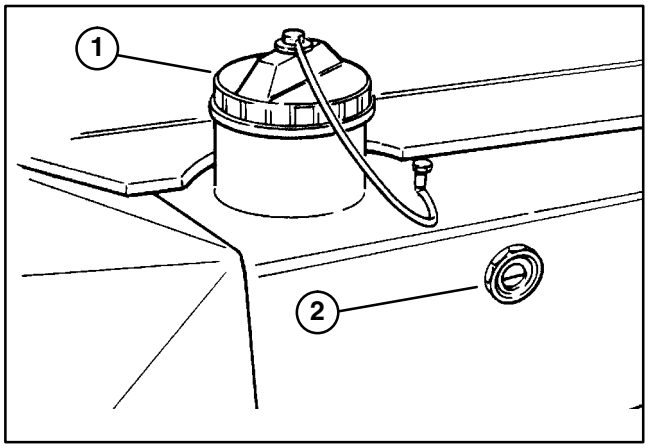


Figure 32

1. **Hydraulic reservoir cap**
2. **Sight gauge**

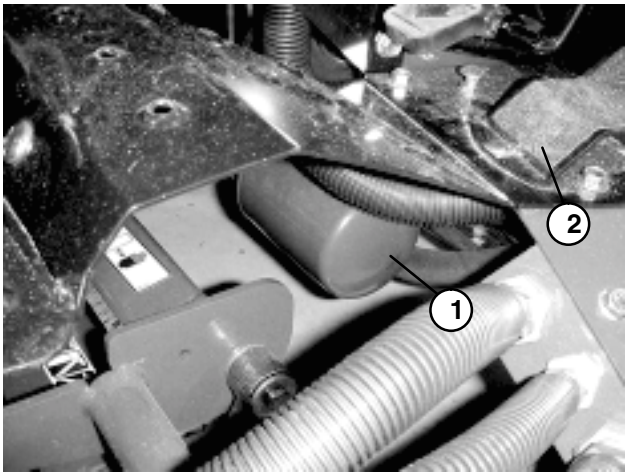


Figure 33

1. **Hydraulic filter**
2. **Footrest**

12. Shut off engine and check for hydraulic oil leaks. Check oil level in hydraulic reservoir and add correct oil if necessary.

13. Operate the machine for two (2) hours under normal operating conditions.

14. Check condition of hydraulic oil. If the fluid shows any signs of contamination, or if you are changing to biodegradable fluid, repeat steps 1 through 14 again.

15. Resume normal operation and follow recommended maintenance intervals.

Hydraulic System Start–up

NOTE: When initially starting the hydraulic system with new or rebuilt components such as motors, pumps, or lift cylinders, it is important that this start–up procedure be used. This procedure reduces the chance of damaging the system or its components from not purging the system of air.

1. After the hydraulic system components have been properly installed and if the traction pump was rebuilt or replaced, make sure traction pump housing is at least half full of clean hydraulic oil.

2. Make sure all hydraulic connections and lines are secured tightly.

3. Make sure hydraulic reservoir is full. Add correct oil if necessary (see Traction Unit Operator's Manual). Drain, flush, and refill hydraulic system reservoir and change oil filter if component failure was severe or system is contaminated.

4. Disconnect electrical connector to the fuel stop solenoid to prevent engine from starting.

5. After repairs, check control linkage for proper adjustment, binding, or broken parts.

6. Make sure traction pedal is in **neutral** and the cutting unit switch is **off**. Turn ignition key switch to start; engage starter for fifteen (15) seconds to prime pump.

7. Attach electrical connector to the fuel stop solenoid.

8. Make sure traction pedal is in **neutral** and the cutting unit switch is **off**. Start engine and run it at low idle. The charge pump should pick up oil and fill the hydraulic system. If there is no indication of fill in 30 seconds, stop the engine and determine the cause.

CAUTION

Be careful when operating the cutting unit reels. Contact with the reel or other moving parts can result in personal injury.

9. After the hydraulic system starts to show signs of fill, accomplish the following:

   A. If a reel motor was replaced or rebuilt, run the cutting units at the minimum speed setting (under no load) for 10 minutes in **both** directions.

   B. If a reel motor drive pump was replaced or rebuilt, run the cutting units at the minimum speed setting (under no load) for 10 minutes.

   C. If a traction pump or a wheel motor was replaced or rebuilt, run the traction unit so the wheels slowly turn for 10 minutes.

10. Operate the traction unit and cutting unit by gradually increasing their work load to full over a 10 minute period.

11. Stop the machine. Check hydraulic reservoir and fill if necessary. Check hydraulic components for leaks and tighten any loose connections.

Hydraulic Pump Drive Belt

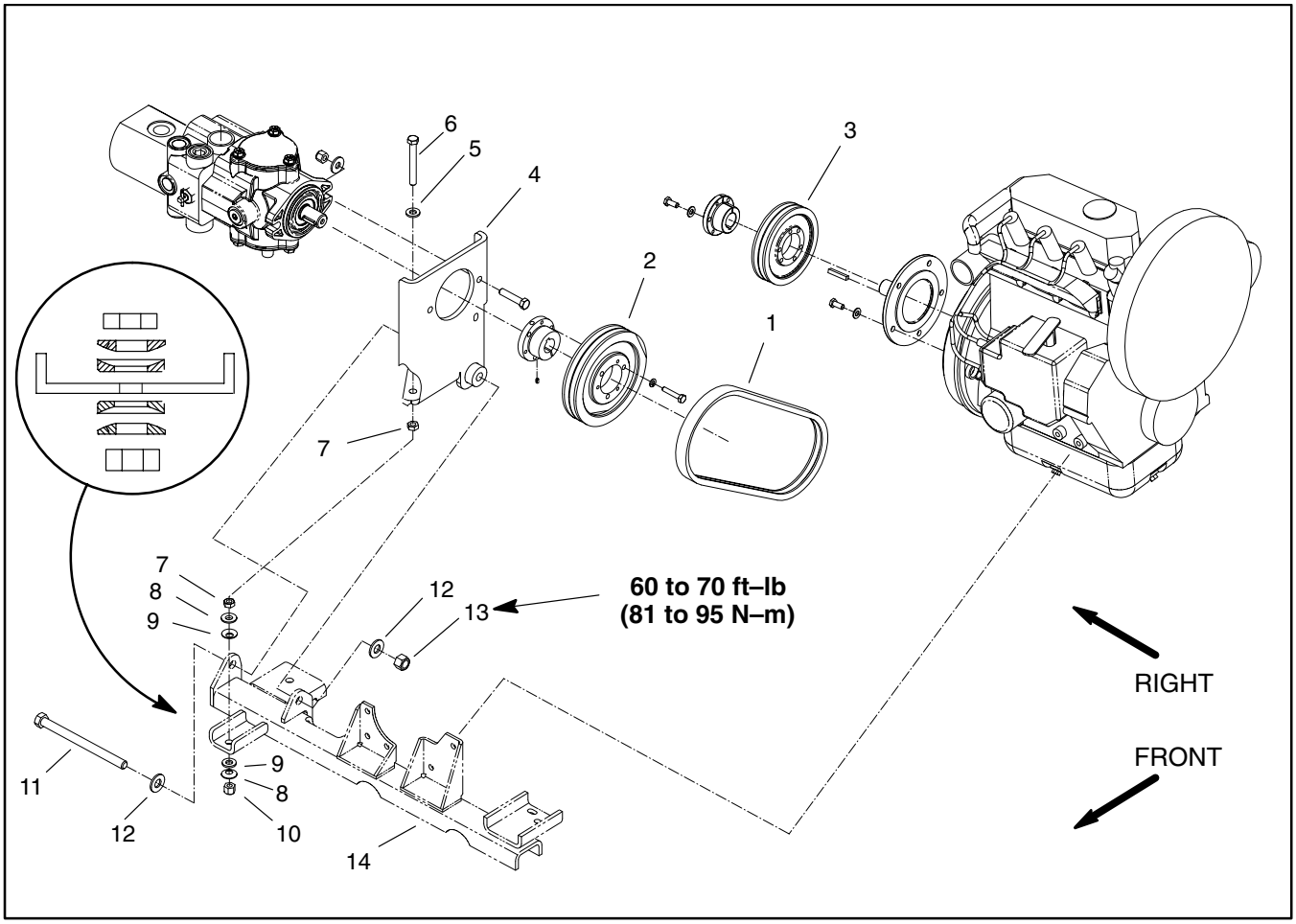


Figure 34

1. **Hydraulic pump drive belt**
2. **Pump pulley**
3. **Engine pulley**
4. **Pump support**
5. **Hardened washer**
6. **Adjusting bolt (full thread)**
7. **Jam nut**
8. **Top spherical washer**
9. **Bottom spherical washer**
10. **Lock nut**
11. **Cap screw**
12. **Thrust washer**
13. **Lock nut**
14. **Front engine frame**

Drive Belt Removal

1. Park the machine on a level surface, engage parking brake, lower cutting units, and stop engine. Remove key from the ignition switch.

2. Loosen lock nut (13) and cap screw (11) that secure lower end of pump support.

3. Loosen lower jam nut and lock nut that secure adjusting bolt to front engine frame.

4. Pivot pump support to allow drive belt to be removed from pulleys.

Drive Belt Installation

1. Pivot pump support and install drive belt to pulleys.

2. Tighten lock nut on adjusting bolt to tension drive belt. A used drive belt should deflect 0.120” (3 mm) with 11 to 13 pounds (5 to 5.9 kg) pressure applied midway in the span of the belt. If drive belt is being replaced, a new drive belt should deflect 0.120” (3 mm) with 15 to 17 pounds (6.8 to 7.7 kg) pressure.

3. Tighten lower jam nut on adjusting bolt to secure belt adjustment.

4. Torque lock nut (13) from 60 to 70 ft–lb (81 to 95 N–m) to secure pump support.

Traction/Charge Pump

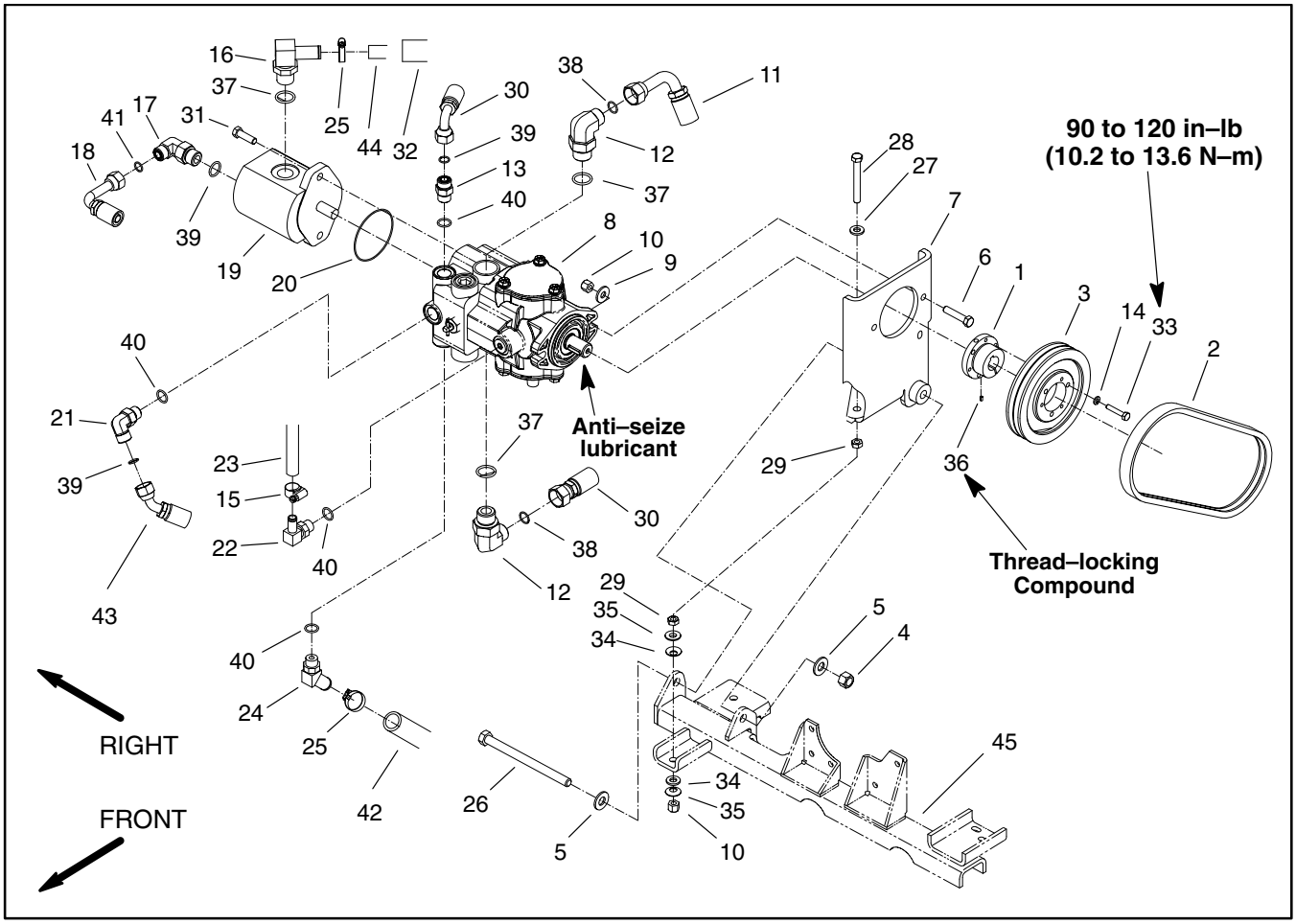


Figure 35

1. Taper lock bushing
2. Hydraulic pump drive belt
3. Pump pulley
4. Lock nut
5. Thrust washer
6. Cap screw
7. Pump support
8. Traction/charge pump
9. Hardened washer
10. Lock nut
11. Hydraulic hose
12. 90º hydraulic fitting
13. Hydraulic adapter
14. Lock washer
15. Hose clamp
16. 90º hydraulic fitting
17. 90º hydraulic fitting
18. Hydraulic hose
19. Reel drive pump
20. O–ring
21. 90º hydraulic fitting
22. 90º hydraulic fitting
23. Return hydraulic hose
24. Hydraulic fitting
25. Hose clamp
26. Cap screw
27. Hardened washer
28. Adjusting bolt (full thread)
29. Jam nut
30. Hydraulic hose
31. Cap screw
32. Protective sleeve
33. Cap screw
34. Top spherical washer
35. Bottom spherical washer
36. Socket head set screw
37. O–ring
38. O–ring
39. O–ring
40. O–ring
41. O–ring
42. Suction hose
43. Hydraulic hose
44. Suction hose
45. Front engine frame

Neutral Arm Assembly

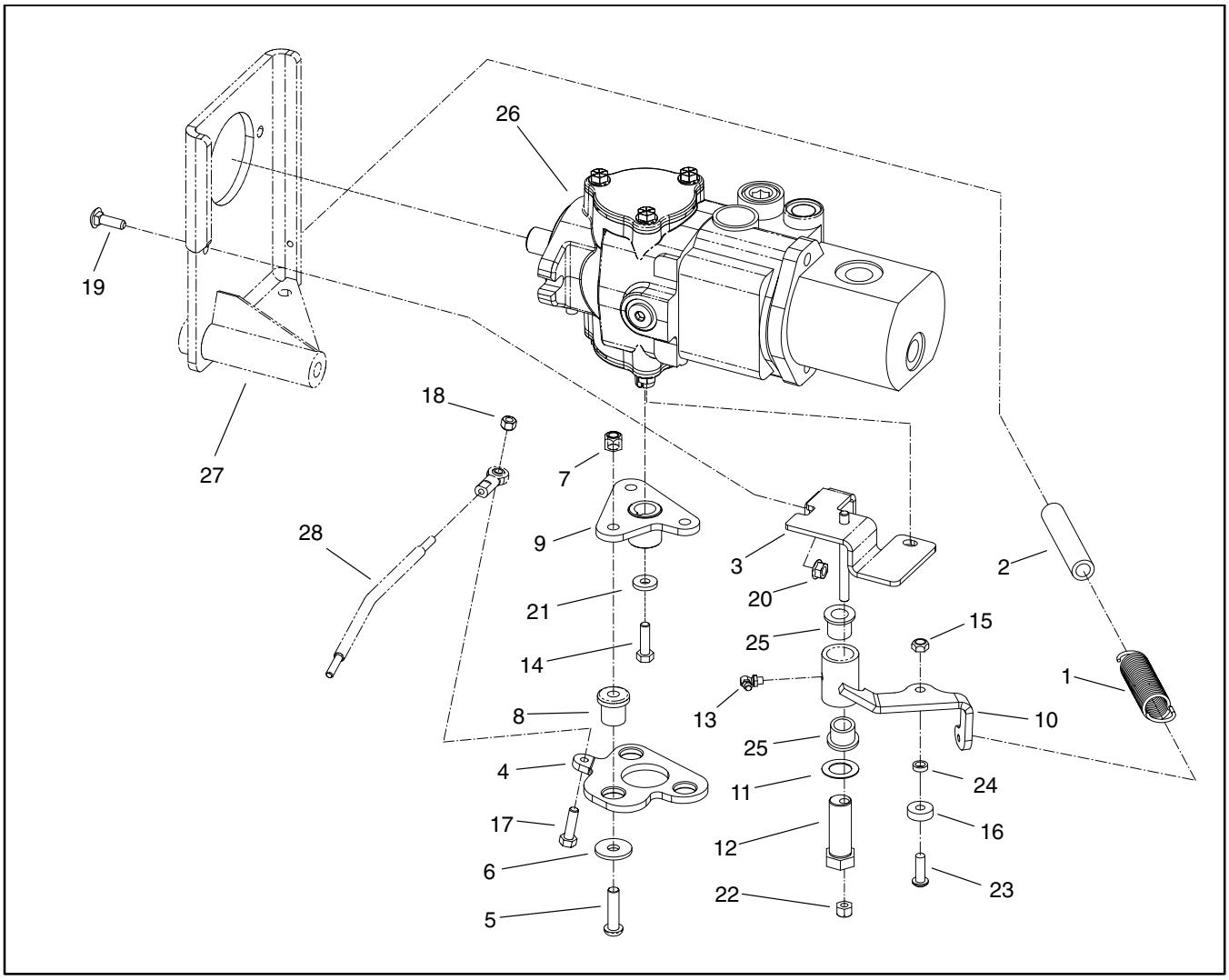


Figure 36

1. Extension spring
2. Hose
3. Neutral bracket
4. Pump lever
5. Screw
6. Washer
7. Lock nut
8. Mount
9. Hub
10. Neutral arm
11. Thrust washer
12. Traction stud
13. Grease fitting
14. Cap screw
15. Lock nut
16. Bearing
17. Cap screw
18. Lock nut
19. Carriage screw
20. Flange nut
21. Flat washer
22. Lock nut
23. Screw
24. Bearing spacer
25. Flange bushing
26. Traction/charge pump
27. Pump support
28. Traction control rod

Removal (Fig. 35)

1. Park the machine on a level surface, engage parking brake, lower cutting units, and stop engine. Remove key from the ignition switch.

CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.

2. Install plug into the hydraulic reservoir to prevent draining the reservoir.

3. Remove traction belt from the pump pulley (see Hydraulic Pump Drive Belt).

IMPORTANT: Mark position of the taper lock bushing on the piston pump shaft. Bushing position is critical for the proper alignment of the traction belt and flywheel pulleys.

4. Remove pulley from the taper lock bushing on the piston pump:

A. Remove cap screws and lock washers securing pulley to the taper lock bushing.

IMPORTANT: Excessive or unequal pressure on the cap screws can break the bushing flange.

B. Insert cap screws into threaded removal holes of the pulley. Tighten screws progressively and evenly until the pulley is loose on the bushing. Remove pulley from the bushing.

5. Remove pump lever and neutral arm assemblies (Fig. 36) from the piston pump as follows:

CAUTION

The extension spring is under tension and may cause personal injury during removal. Use caution when removing spring from the neutral arm.

A. Remove extension spring from the pump support and neutral arm.

B. Disconnect traction control rod from the pump lever by removing cap screw and lock nut.

C. Remove cap screw and washer securing the neutral bracket to the piston pump. Remove flange nut and carriage screw securing the neutral bracket to the pump support.

D. Remove cap screw and flat washer securing the pump lever to the piston pump trunnion.

E. Separate pump lever assembly from pump trunnion and neutral bracket assembly from pump support. Locate and remove key from pump trunnion.

6. Disconnect all hydraulic hoses connected to the hydraulic fittings on the piston and reel drive pumps. Allow hoses to drain into a suitable container. Cap or plug openings of pumps and hoses to prevent contamination.

CAUTION

Support piston and gear pumps when removing them from the pump support to prevent them from falling and causing personal injury.

7. Remove both cap screws, hardened washers, and lock nuts securing the piston pump to the pump support. Pull pump assembly from the machine.

8. Remove reel drive pump from the piston pump (see Reel Drive Pump Removal).

9. Remove hydraulic fittings and O–rings from the pumps as required.

10. If necessary, loosen socket head set screw in taper lock bushing and remove bushing from the piston pump shaft. Locate and remove key from piston pump shaft.

Piston Pump Installation (Fig. 35)

1. Make sure the inside of the taper lock bushing is clean. Apply anti–seize lubricant to both the piston pump shaft and the inside of the taper lock bushing. Position key to pump shaft. Slide bushing onto shaft.

2. Apply medium strength thread–locking compound to bushing socket head set screw. Secure taper lock bushing to the marked position on the piston pump shaft with set screw.

3. Remove caps and plugs that were placed during disassembly from pumps. Install O–rings and hydraulic fittings to their original positions on the piston and reel drive pumps.

4. Install reel drive pump to piston pump (see Reel Drive Pump Installation).

CAUTION

Support piston and gear pumps when installing them to the pump support to prevent them from falling and causing personal injury.

5. Position pump assembly to the pump support. Secure piston pump to the pump support with both cap screws, hardened washers, and lock nuts.

6. Remove plugs that were placed during disassembly from hydraulic hoses. Connect all hydraulic hoses that were removed during disassembly.

7. Install pump lever and neutral arm assemblies (Fig. 36) to the piston pump as follows:

A. Position neutral bracket assembly to the pump and pump support. Secure neutral bracket to pump with cap screw and washer. Secure neutral bracket to pump support with carriage screw and flange nut.

B. Place key in pump trunnion and slide pump lever assembly onto trunnion. Secure pump lever to the trunnion with flat washer and cap screw.

C. Connect traction control rod to the pump lever with cap screw and lock nut.

CAUTION

The extension spring is under tension and may cause personal injury during installation. Use caution when installing the spring to the neutral arm.

D. Install extension spring and hose to the neutral arm and pump support.

8. Install pulley to the taper lock bushing.

   A. Place pulley to the bushing. Align non–threaded holes of pulley with threaded holes of bushing.

   B. Secure pulley to bushing with cap screws and lock washers. Torque cap screws from 90 to 120 in–lb (10.2 to 13.6 N–m) in a circular pattern.

   C. Verify alignment across engine and pump pulley faces with a straight edge. The gap between both faces must not exceed 0.030" (0.8 mm).

9. Install drive belt to the pulleys (see Hydraulic Pump Drive Belt).

10. Check traction drive for neutral and neutral switch adjustment (see Traction Unit Operator's Manual).

11. Remove plug from the hydraulic reservoir.

12. Follow Hydraulic System Start–up procedures.

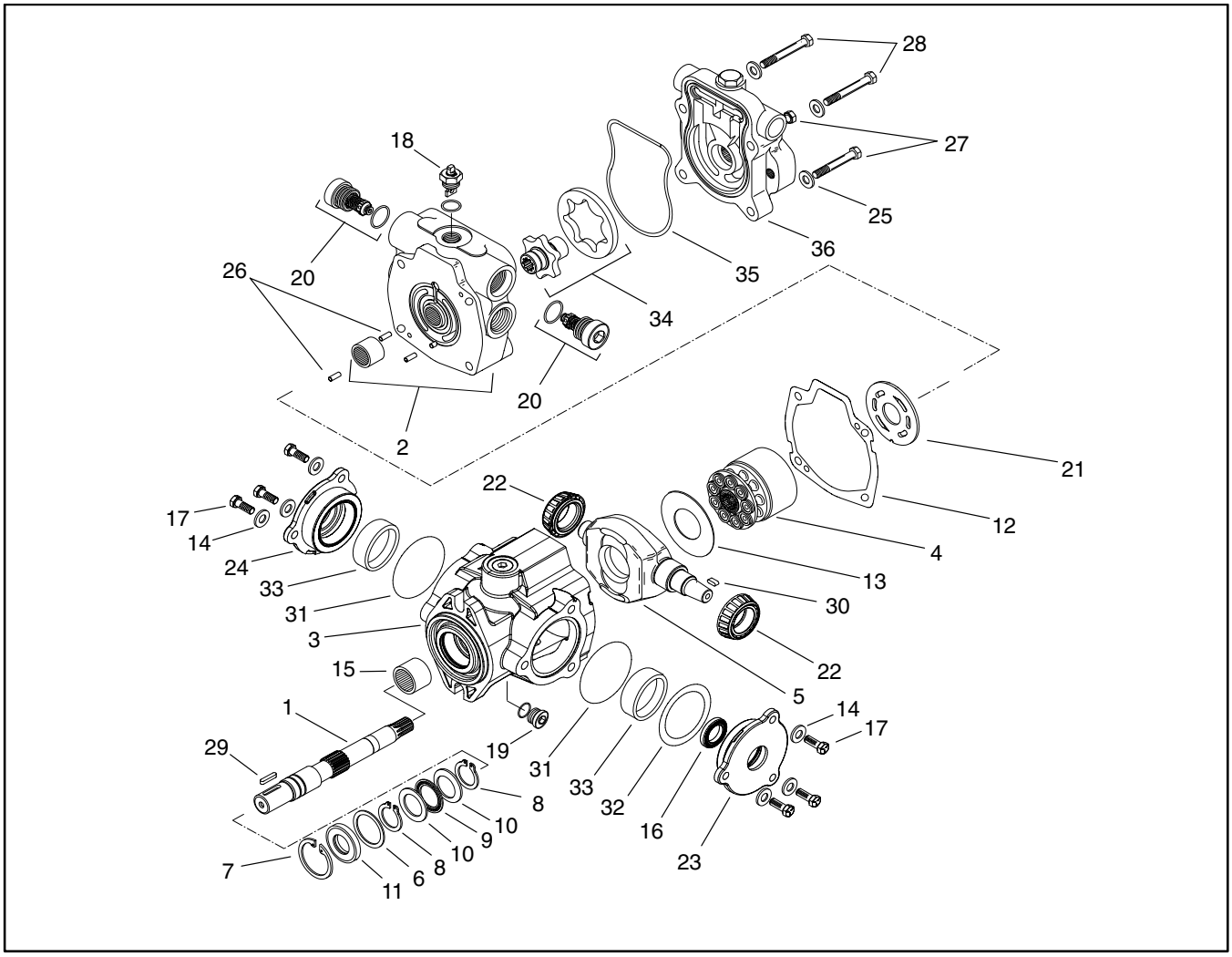


Figure 37

1. Drive shaft
2. End cover
3. Housing
4. Rotating kit
5. Camplate
6. Washer
7. Snap ring
8. Retaining ring
9. Thrust bearing
10. Thrust washer
11. Drive shaft seal
12. Housing gasket
13. Camplate insert
14. Washer
15. Bearing
16. Camplate shaft seal
17. Cap screw
18. Bypass valve
19. Plug
20. Check valve
21. Valve plate
22. Bearing cone
23. Cover plate
24. Cover plate
25. Washer
26. Dowel pin
27. Cap screw
28. Cap screw
29. Key
30. Key
31. O–ring
32. Shim kit
33. Bearing cup
34. Geroter and coupler assembly
35. O–ring
36. Charge pump adapter

NOTE: For repair of the traction/charge pump, see the Eaton Medium Duty Piston Pump Repair Information Model 70160 Variable Displacement Piston Pump at the end of this chapter.

Reel Gear Pump

Removal (Fig. 38)

1. Park the machine on a level surface, engage the parking brake, lower the cutting units, and stop the engine. Remove the key from the ignition switch.

CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.

2. Clean reel gear pump and hydraulic connections. Install plug into the hydraulic reservoir. Label all hose connections for reassembly purposes. Matchmark fittings and pump to allow correct reassembly. Put caps or plugs on any hydraulic lines or fittings left open or exposed.

3. Loosen hose clamp (2) and remove hose (3) from fitting. Allow hydraulic oil to drain from hose into a suitable container.

4. Disconnect hose (5) from elbow fitting (6). Allow hydraulic oil to drain from hose into a suitable container.

5. Remove fittings and O–rings from the pump.

6. Support reel drive pump and remove two cap screws. Separate reel gear pump and O–ring (11) from the traction pump.

Installation (Fig. 38)

1. Make sure mounting and O–ring sealing surfaces on reel gear pump and traction pump are clean.

2. Remove caps or plugs that were put on any hydraulic lines or fittings during disassembly.

3. Replace all O–rings with new ones. Apply clean hydraulic oil to all O–rings.

4. Place O–ring (11) on reel gear pump.

5. Position reel gear pump to traction pump; the inlet port on the reel gear pump should be facing up. Align splines on reel gear pump shaft with traction pump shaft.

6. Secure reel gear pump to traction pump with cap screws. Torque cap screws from 27 to 33 ft–lb (37 to 44 N–m).

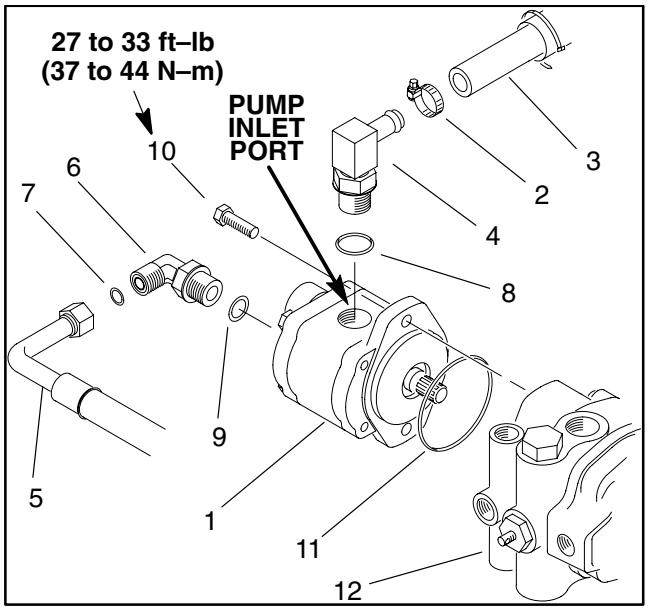


Figure 38

1. Reel gear pump
2. Hose clamp
3. Hose
4. 90º hydraulic fitting
5. Hose
6. Elbow fitting
7. O–ring
8. O–ring
9. O–ring
10. Cap screw
11. O–ring
12. Traction pump

7. Remove caps or plugs from any hydraulic lines or fittings that were installed during disassembly process. Inspect threads and sealing surfaces of connectors. Replace any damaged or worn connectors.

8. Install O–rings (8 and 9). Install fitting (4) and elbow fitting (6) and use matchmarks to correctly orient fittings.

9. Secure hose (3) to connector and tighten hose clamp. Secure hose (5) to elbow fitting and tighten hose connector.

10. Remove plug from hydraulic reservoir.

11. Follow Hydraulic System Start–up procedures.

Reel Gear Pump Service (Barnes)

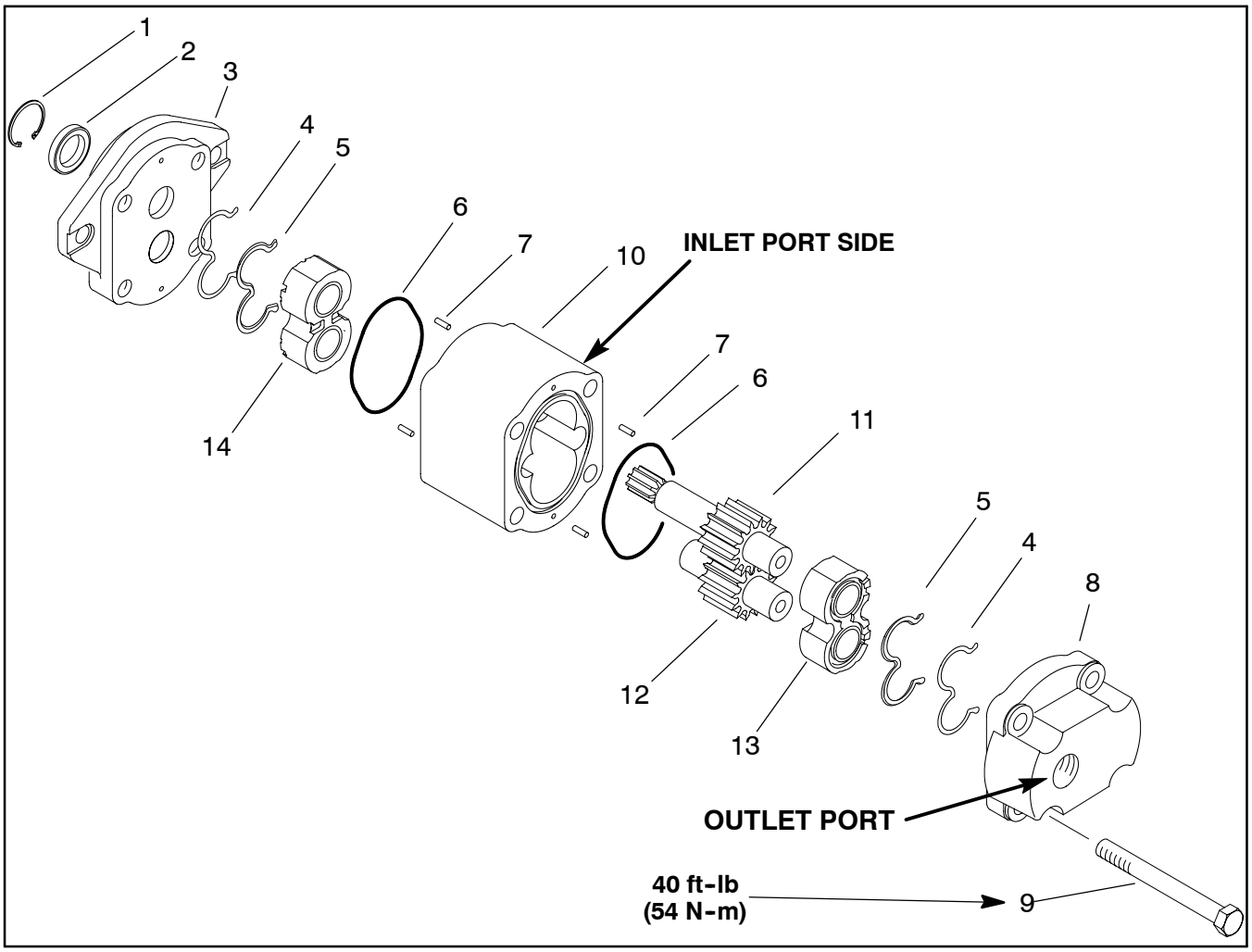


Figure 39

1. Retaining ring
2. Shaft seal
3. Mounting flange
4. Backup ring
5. E-seal
6. O-ring
7. Dowel pin
8. End cover
9. Bolt
10. Gear housing
11. Drive gear
12. Idler gear
13. Rear bearing block
14. Front bearing block

Disassembly (Fig. 39)

1. Tape the shaft end of the drive gear (11) to prevent damaging the shaft seal when the shaft is removed or reinstalled.

2. Matchmark the inlet side of the gear housing (10) with the mounting flange (3) and the end cover (8) for proper orientation of these three parts during reassembly.

3. Position the pump with the drive end facing down.

4. Remove the four bolts. Lift off the end cover and two dowel pins.

5. Remove the gear housing ensuring the rear bearing block (13), front bearing block (14), drive gear (11), and idler gear (12) remain together. Remove the remaining two dowel pins from the gear housing.

6. Remove the rear bearing block from the drive and idler gear shafts.

7. Remove the idler gear.

8. Remove the drive gear shaft carefully from the mounting flange. Remove the front bearing block from the drive gear shaft.

Shaft Seal Replacement (Fig. 39)

1. Place the mounting flange on a clean working surface with the shaft seal (2) up. Remove the retaining ring.

NOTE: Avoid scratching or marring the shaft seal bore in the mounting flange. Damage to the bore may cause the shaft seal to leak around the outer diameter of the seal.

2. Carefully remove the shaft seal. Clean any contamination from the seal bore.

3. Place a new shaft seal with the part number side up into the seal bore. Apply uniform pressure to the face of the shaft seal while pressing it into the bore. This method should prevent damage or misalignment of the seal in the bore.

4. Install new retaining ring into the mounting flange.

E–seal and Backup Ring Replacement (Fig. 39)

1. Place the front bearing block on a clean surface. Remove the old backup ring and E–seal. Clean any contamination from the E–seal groove.

2. Apply a light coating of petroleum jelly in the E–seal groove of the front bearing block and on the flat side of the E–seal to help keep the seals in place during assembly.

3. Place the E–seal with its flat side up into the seal groove on the front bearing block. Place the backup ring into the groove made by the E–seal and bearing block. Make sure the notches in the center of the backup ring and E–seal line up so that the backup ring sits flush with the E–seal.

4. Repeat the above steps for the rear bearing block.

O–ring Replacement (Fig. 39)

1. Remove the old O–rings from the gear housing. Clean any contamination from the O–ring groove.

2. Apply a light coating of petroleum jelly in the O–ring grooves of the gear housing. Place a new O–ring in each groove.

Reassembly (Fig. 39)

1. Place the mounting flange with the shaft seal side down onto a clean working surface. Make sure that the back side of the mounting flange is free of any contamination.

2. Place the front bearing block with its seal side down onto the mounting flange. The open side of the E–seal should point toward the matchmark on the inlet side of the mounting flange.

3. Apply a light coating of hydraulic oil to the exposed face of the front bearing block. Make sure the tape is on the shaft end of the drive gear. Insert the shaft end of the drive gear carefully through the front bearing block and the shaft seal being careful not to damage the shaft seal.

4. Place the shaft of the idler gear into the remaining position of the front bearing block. Apply a light coating of oil to the back face of the drive and idler gears.

5. Place the rear bearing block (with seal side up) onto the drive and idler gear shaft ends. Make sure that the open side of the E–seal is pointing towards the inlet of the pump.

6. Install two dowel pins into the mounting flange.

7. Align the matchmarks on the gear housing and mounting flange. Slide the gear housing down over the gears and bearing blocks.

8. Make sure the rear bearing block face sits just below the back face of the gear housing. If the rear bearing block sits higher than the rear face of the gear housing, remove the gear housing. Check that the E–seal, backup ring, or O–ring did not shift out of place during assembly.

9. Place the remaining two dowel pins into the rear of the gear housing. Align matchmarks and set end cover on the rear of the gear housing.

10. Insert the four bolts through the bolt holes in the end cover and gear housing. Hand tighten each bolt and then torque to 40 ft–lb (54 N–m).

11. Place a small amount of oil in the inlet of the pump. Rotate the drive shaft away from the inlet one revolution. If the drive shaft binds while rotating, disassemble the pump and check for assembly problems, and then reassemble pump.

Reel Gear Pump Service (Casappa)

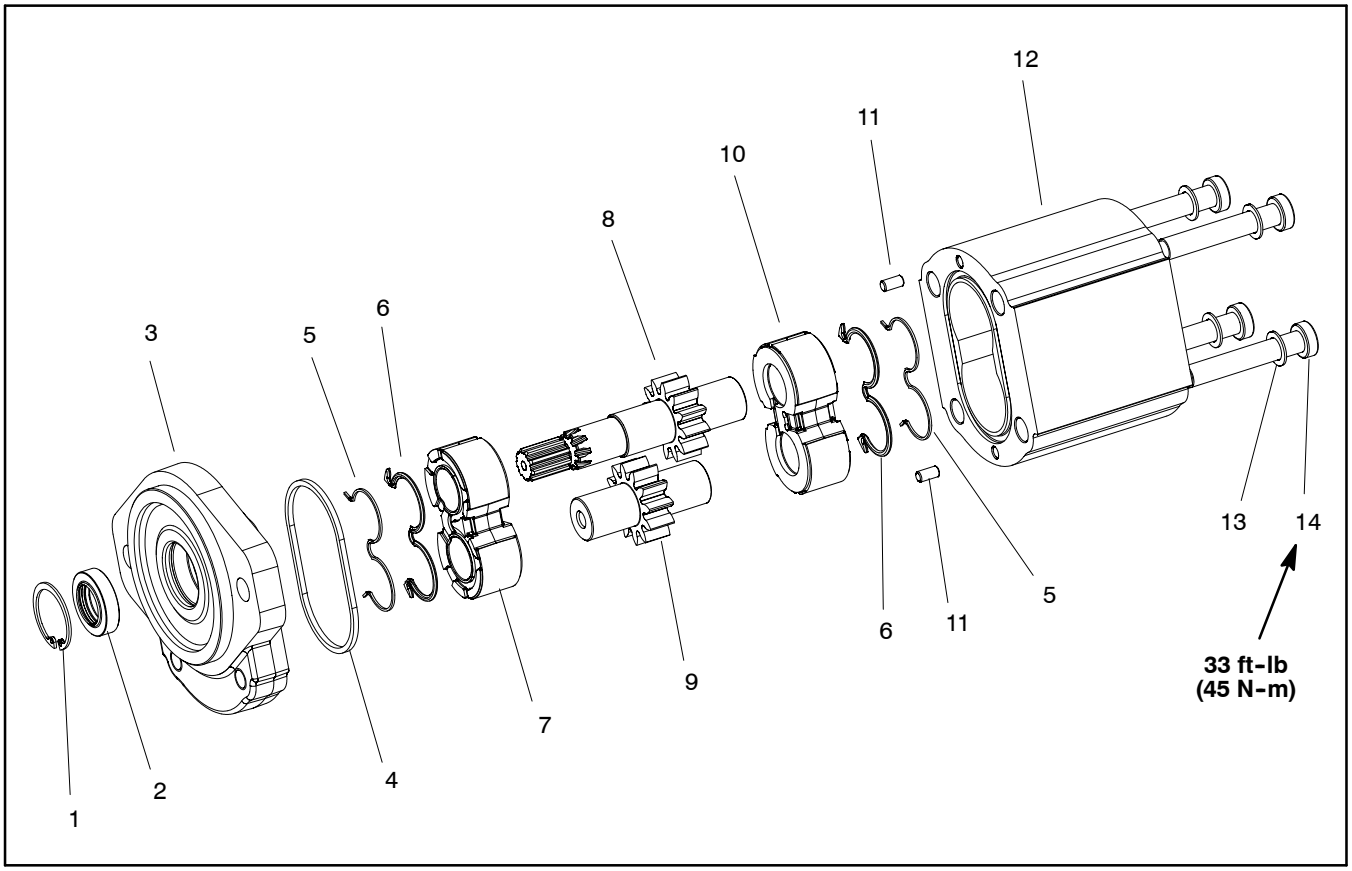


Figure 39.1

1. **Retaining ring**
2. **Shaft seal**
3. **Front flange**
4. **O-ring**
5. **Pressure seal**
6. **Back-up gasket**
7. **Front wear plate**
8. **Drive shaft**
9. **Idler gear**
10. **Rear wear plate**
11. **Dowel pin**
12. **Body**
13. **Washer (4 used)**
14. **Cap screw (4 used)**

Disassembly (Fig. 39.1)

NOTE: The gear pump must be replaced as a complete assembly. Individual gears, body and wear plates are not available separately. Disassemble gear pump for cleaning, inspection and seal replacement only.

1. Plug pump ports and clean the outside of the pump thoroughly. After cleaning, remove plugs and drain any oil out of the motor.

2. Use a marker to make a **diagonal** line across the front flange and body for assembly purposes (Fig. 39.2).

IMPORTANT: Use caution when clamping gear pump in a vise to avoid distorting any pump components.

3. Secure the front cover of the pump in a vise with the drive shaft pointing down.

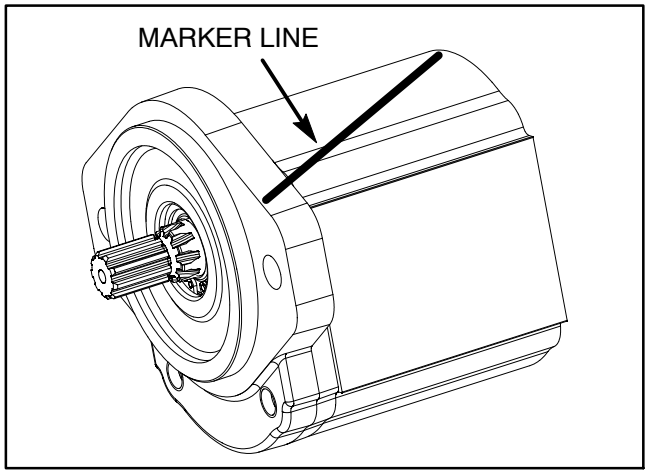


Figure 39.2

4. Loosen the four (4) cap screws that secure pump assembly.

5. Remove pump from vise and remove fasteners.

6. Support the pump assembly and gently tap the pump case with a soft face hammer to loosen the pump sections. Be careful to not drop parts or disengage gear mesh.

IMPORTANT: Mark the relative positions of the gear teeth and the wear plates so they can be reassembled in the same position. Do not touch the gear surfaces as residue on hands may be corrosive to gear finish.

7. Remove the wear plates and seals from each pump section. Before removing each gear set, apply marking dye to mating teeth to retain "timing". Pump efficiency may be affected if the teeth are not installed in the same position during assembly. Discard removed seals.

8. Turn front flange over, with seal side up.

IMPORTANT: Make sure to not damage the front flange counter bore when removing the seal from the front flange.

9. Carefully remove retaining ring and shaft seal from the front flange. Discard seal.

10. Clean all parts. Check all components for burrs, scoring, nicks and other damage.

11. Replace the entire pump assembly if parts are excessively worn or scored.

Assembly (Fig. 39.1)

1. Lubricate O-ring, pressure seals, back-up gaskets and wear plate grooves with a thin coat of petroleum jelly to hold them in position during gear pump assembly. Lubricate all other internal parts freely with clean hydraulic oil.

NOTE: Pressure seals and back-up gaskets fit in grooves machined into wear plates. The O-ring seal fits in groove machined in body face.

2. Assemble pump starting at front cover end.

3. After pump has been assembled, tighten cap screws by hand. Rotate the drive shaft to check for binding. Protect the shaft if using a pliers.

4. Tighten the four (4) cap screws evenly in a crossing pattern to a torque of 33 ft-lb (45 N-m).

Wheel Motor

Front Wheel Motor Removal (Fig. 40)

1. Park the machine on a level surface, engage the parking brake, lower the cutting units, and stop the engine. Remove the key from the ignition switch.

CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.

2. Remove wheel and brake assembly from unit (see Repair section of Chapter 6 – Chassis).

3. Clean wheel motor and hydraulic connections. Label all tube hose connections for reassembly purposes. Put caps or plugs on any hydraulic lines or fittings left open or exposed.

4. Disconnect tube connections from hydraulic fittings on motor to be removed. On the left–hand wheel motor, also disconnect hydraulic hose (4) from hydraulic fitting on motor. Allow hydraulic oil to drain from tubes and hose into a suitable container.

5. Support wheel motor. Remove four socket head screws and lock nuts from support frame. Remove brake bracket (13), grass shield (14), and spacers (15). Pull wheel motor from the support frame.

6. Remove hydraulic fittings and O–rings from the wheel motor.

Front Wheel Motor Installation (Fig. 40)

1. Place and support wheel motor into the support frame. Insert four socket head screws through the support frame and wheel motor.

2. Slide spacers, grass shield, and brake bracket onto the cap screws and wheel motor. Tighten lock nuts onto cap screws.

3. Remove caps or plugs that were put on any hydraulic lines or fittings during disassembly.

4. Install hydraulic fittings (5 and 6) onto the wheel motor. On the left–hand wheel motor, also install hydraulic fitting (7) onto the wheel motor. Tighten hydraulic fittings.

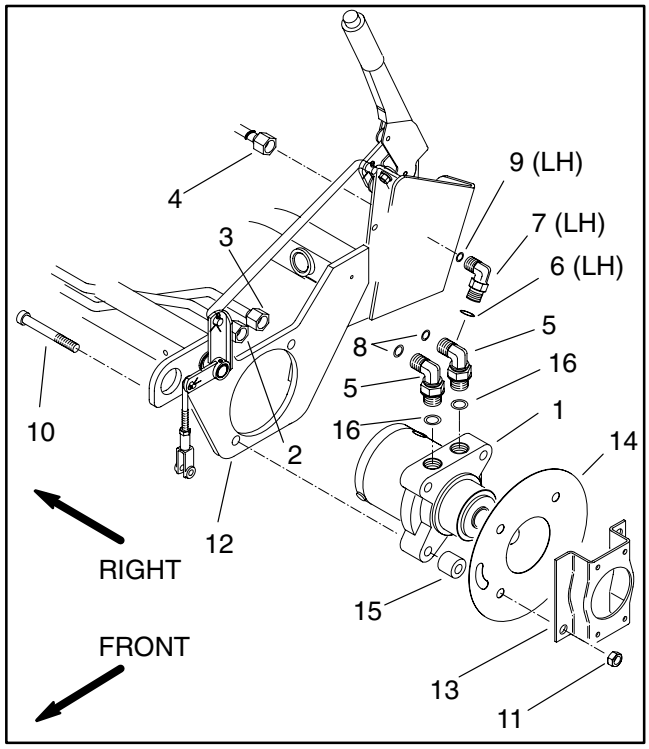


Figure 40

1. **Wheel motor (LH shown)**
2. **Tube connection**
3. **Tube connection**
4. **Hyd. hose (LH motor)**
5. **Hydraulic fitting**
6. **O–ring (LH motor)**
7. **Hyd. fitting (LH motor)**
8. **O–ring**
9. **O–ring (LH motor)**
10. **Socket head screw**
11. **Lock nut**
12. **Support frame**
13. **Brake bracket**
14. **Grass shield**
15. **Spacer**
16. **O–ring**

5. Install tube connections to hydraulic fittings on wheel motor. On the left–hand motor, also install hose connection (4) to hydraulic fitting (7). Tighten connections.

6. Install wheel and brake to machine (see Repair section of Chapter 6 – Chassis).

7. Follow Hydraulic System Start–up procedures.

3WD Rear Wheel Motor Removal (Fig. 41)

If the optional 3 Wheel Drive Kit has been installed, rear wheel motor removal procedure is as follows.

1. Park the machine on a level surface, engage the parking brake, lower the cutting units, and stop the engine. Remove the key from the ignition switch.

CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.

2. Clean wheel motor and hydraulic connection. Put caps or plugs on any hydraulic lines or fittings left open or exposed.

3. Remove wheel and wheel hub from unit (see Repair section of Chapter 6 – Chassis).

4. Disconnect hose connections from hydraulic fittings. Remove O–rings. Allow hydraulic oil to drain from the hose into a suitable container.

5. Support wheel motor. Remove four socket head screws and lock nuts from the rear wheel fork. Pull wheel motor from the rear wheel fork.

6. Remove hydraulic fittings and O–rings from the wheel motor.

3WD Rear Wheel Motor Installation (Fig. 41)

If the optional 3 Wheel Drive Kit has been installed, rear wheel motor installation procedure is as follows.

1. Place and support wheel motor into the rear wheel fork. Insert four socket head screws through the rear wheel fork and wheel motor.

2. Tighten lock nuts onto socket head screws.

3. Remove caps or plugs that were put on any hydraulic lines or fittings during disassembly.

4. Install hydraulic fittings and O–rings onto the wheel motor. Tighten hydraulic fittings.

5. Install O–rings while connecting hose connections onto the hydraulic fittings. Tighten connections.

6. Install wheel and wheel hub to unit (see Repair section of Chapter 6 – Chassis).

7. Follow Hydraulic System Start–up procedures.

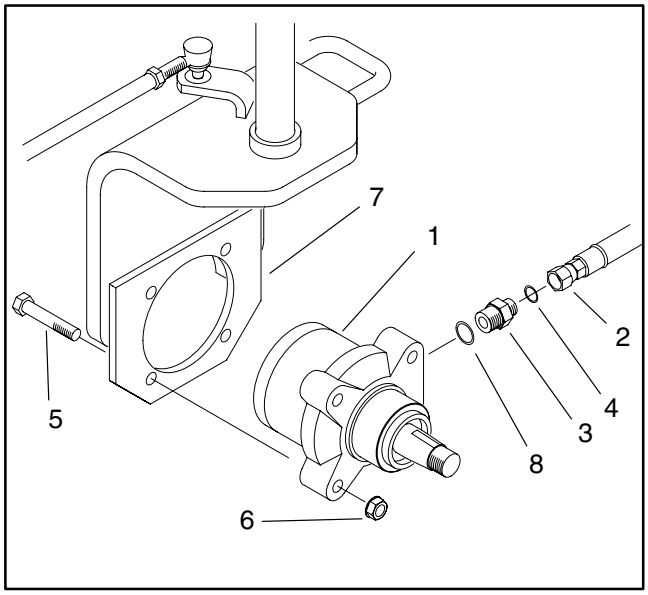


Figure 41

1. **Wheel motor**
2. **Hose connection**
3. **Hydraulic fitting**
4. **O–ring**
5. **Socket head screw**
6. **Lock nut**
7. **Rear wheel fork**
8. **O–ring**

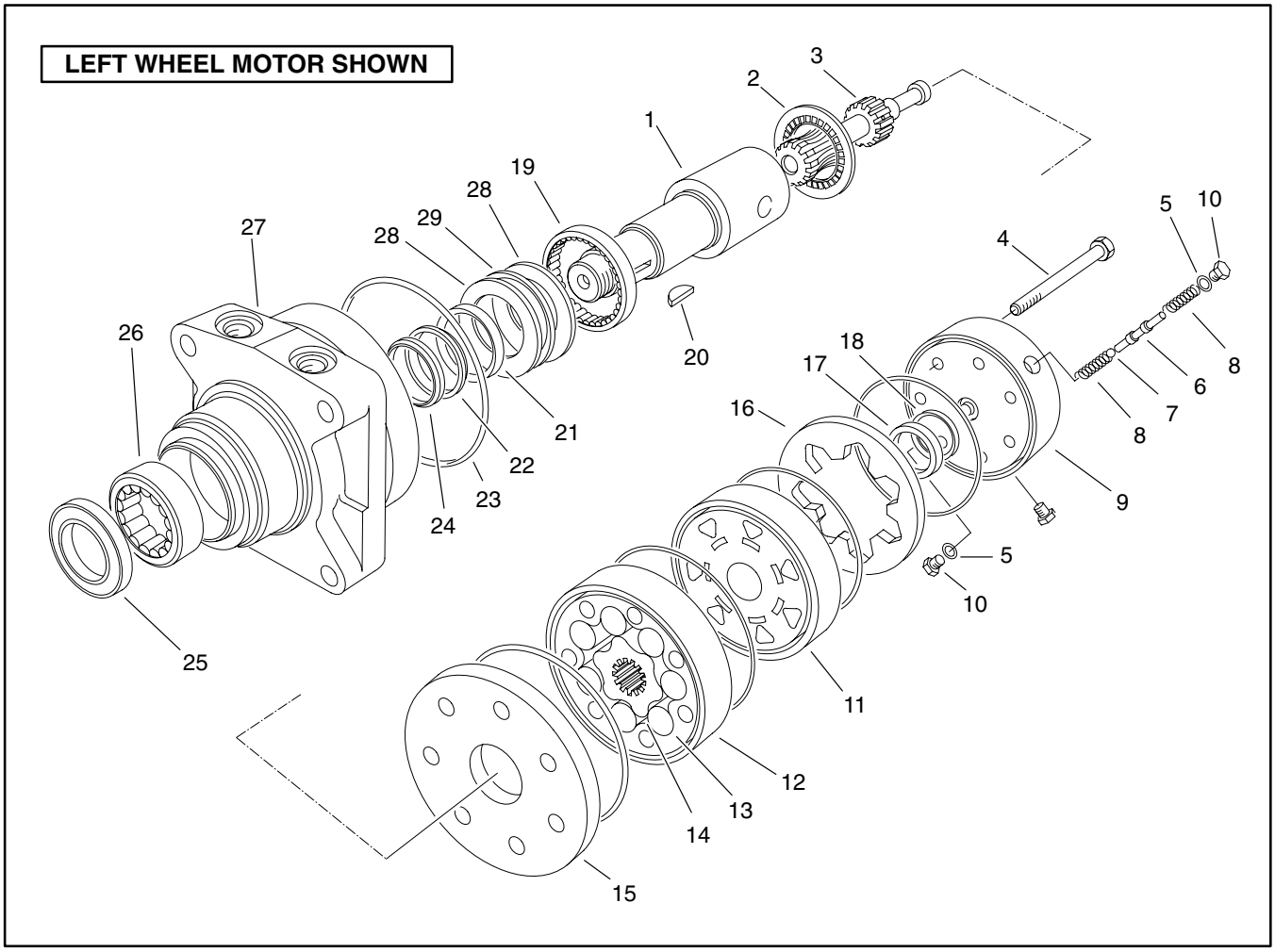


Figure 42

1. **Coupling shaft**
2. **Thrust bearing**
3. **Drive link**
4. **Cap screw**
5. **O–ring**
6. **Shuttle valve**
7. **Ball**
8. **Spring**
9. **End cover**
10. **Plug**
11. **Manifold**
12. **Stator**
13. **Vane**
14. **Rotor**
15. **Wear plate**
16. **Commutator ring**
17. **Commutator**
18. **Commutator seal**
19. **Bearing**
20. **Woodruff key**
21. **Inner seal**
22. **Back–up washer**
23. **Seal ring**
24. **Back–up washer**
25. **Dirt and water seal**
26. **Bearing**
27. **Housing**
28. **Thrust washer**
29. **Thrust bearing**

NOTE: The wheel motor shown in Figure 42 is the left motor. The two wheel motors are identical in construction except for end cover differences. The end cover of the right motor lacks the shuttle valve and plugs of the left motor shown. On machines equipped with the optional 3 Wheel Drive Kit, the wheel motor for the rear wheel is identical to the right motor.

NOTE: For repair of the wheel motors, see the Ross Torqmotor ™ MG, MF, ME, and MJ Series Service Procedure at the end of this chapter.

Cutting Reel Motor

Removal (Fig. 43)

1. Park the machine on a level surface, engage the parking brake, lower the cutting units, and stop the engine. Remove the key from the ignition switch.

CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.

2. Remove reel motor from cutting unit (see Repair section of Chapter 7 – Cutting Units).

3. Unscrew flange nut and remove coupling from reel motor using a puller. Locate and retrieve key.

4. Clean motor, fittings, and hose connections.

NOTE: The position of the fittings on the reel motor is critical to reconnecting hydraulic hoses.

5. Label all hose connections for reassembly purposes. Matchmark reel motor and all hydraulic fittings for reassembly purposes.

6. Remove hose connections from hydraulic fittings. Allow hydraulic oil to drain from hose into a suitable container. Put caps or plugs on disconnected hoses to prevent contamination.

7. Remove hydraulic fittings and O–rings from reel motor. Discard O–rings.

Installation (Fig. 43)

1. Position key and place coupling on reel motor shaft.

2. Install flange nut and torque nut 35 ft–lb (47 N–m).

3. Make sure hydraulic fitting ports and O–ring sealing surfaces on the reel motor are clean.

4. Remove caps or plugs that were put on any hydraulic lines or fittings during disassembly.

5. Apply clean hydraulic oil to all O–rings.

6. Inspect threads and sealing surfaces of hydraulic fittings. Replace any damaged or worn fittings.

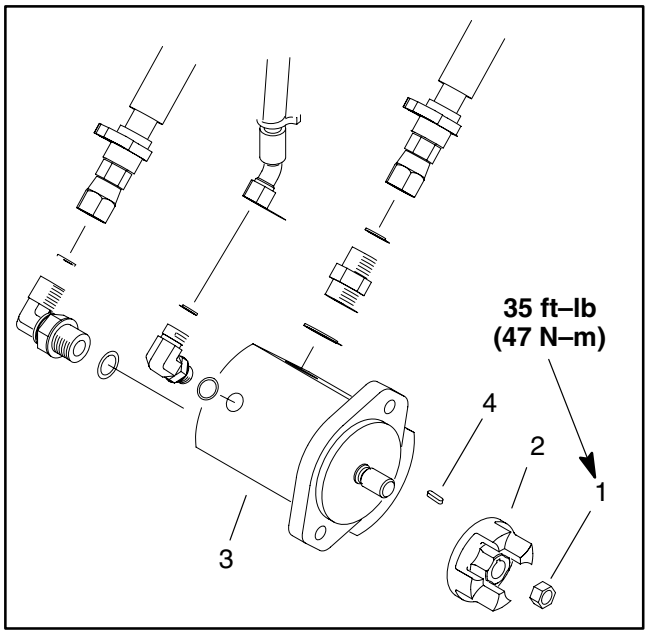


Figure 43

1. **Flange nut**
2. **Coupling**
3. **Reel motor**
4. **Key**

7. Place O–ring on face seal of hydraulic fitting. Secure hydraulic fitting to the reel motor ensuring that the matchmarks are aligned. Repeat this step for the remaining hydraulic fittings.

8. Inspect threads and sealing surfaces of hose connections. Replace any damaged or worn connections.

9. Secure hose connection to the hydraulic fitting. Repeat this step for the remaining hydraulic fittings.

10. Install reel motor to cutting unit (see Repair section of Chapter 7 – Cutting Units).

11. Follow Hydraulic System Start–up procedures.

Cutting Reel Motor Service (Serial Number Below 290000000)

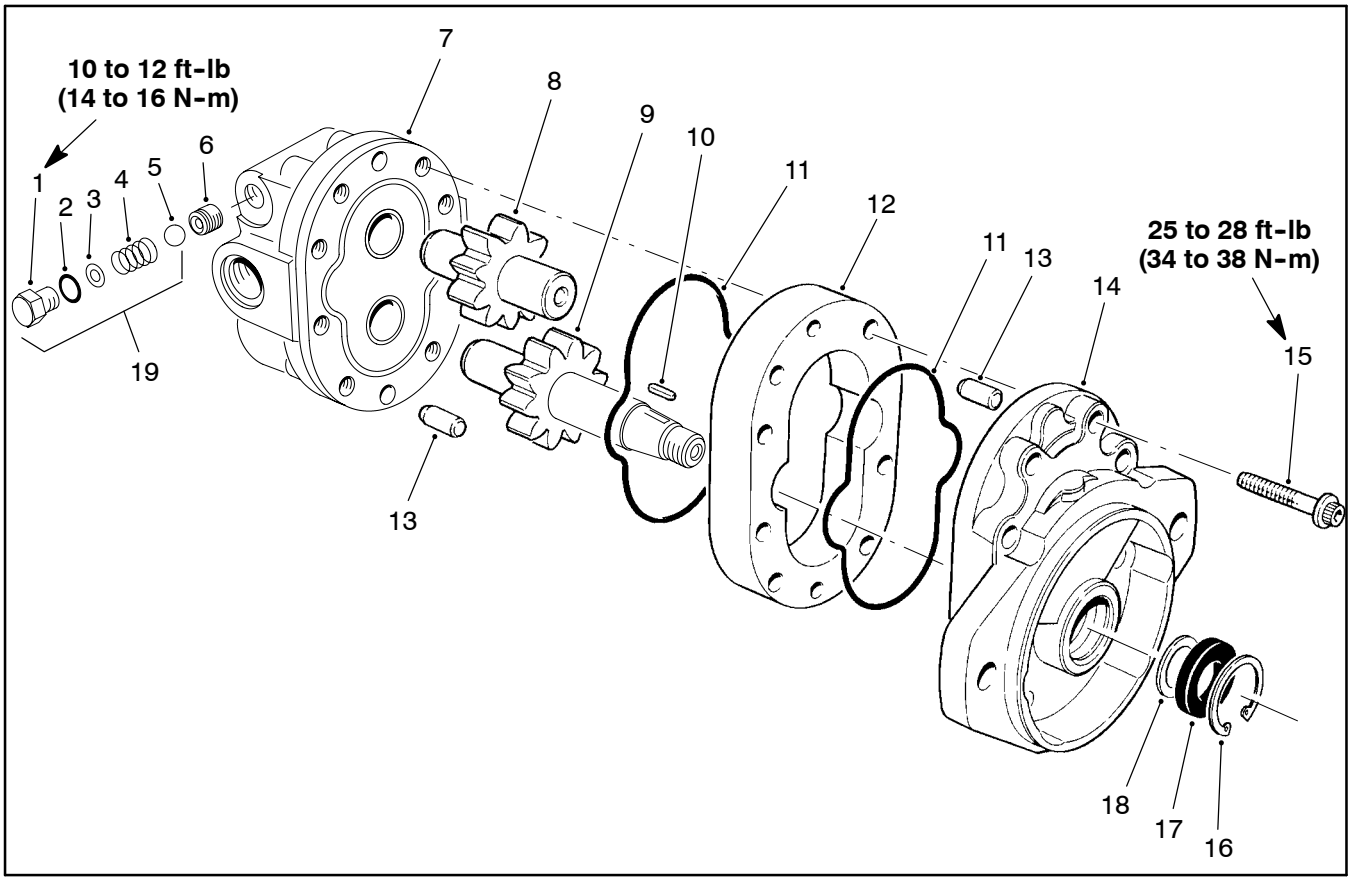


Figure 44

1. **Relief valve plug**
2. **O-ring**
3. **Shim**
4. **Spring**
5. **Ball**
6. **Relief valve seat**
7. **Backplate**
8. **Idler gear assembly**
9. **Drive gear assembly**
10. **Key**
11. **O-ring**
12. **Body**
13. **Alignment pin**
14. **Frontplate**
15. **Screw**
16. **Retaining ring**
17. **Oil seal**
18. **Backup washer**
19. **Relief valve assembly (# 1 thru 5)**

The front cutting reel motors are identical. The rear cutting reel motor has a different back plate than the front motors. Service for front and rear reel motors is identical.

Disassembly (Fig. 44)

1. Make sure key is removed from the drive gear shaft.

2. Matchmark frontplate, body, and backplate to assure proper reassembly.

3. Secure the motor in a vise with the drive shaft up.

4. Remove all eight screws.

5. Remove the motor from the vise. Remove the frontplate from the body. A wooden block or soft face hammer can be used to gently tap the motor when freeing the frontplate.

6. Remove alignment pin from the body. Remove drive gear (9) and idler gear (8) from the body.

7. Remove body from the backplate. Remove O-rings from the body and backplate and discard.

8. Remove alignment pin from the backplate.

9. Remove retaining ring, oil seal, and backup washer from the frontplate.

IMPORTANT: Do not remove the relief valve assembly (19) unless testing shows it to be faulty. The relief valve assembly must be replaced as a complete unit. Both relief valve seats (6) are sealed in place with locking compound; do not remove them.

10. If necessary, remove relief valve plug, O–ring, shim, spring, and ball from the backplate.

Inspection (Fig. 44)

1. Remove all nicks and burrs from all parts with an emery cloth

CAUTION

Use eye protection such as goggles when using compressed air

2. Clean all parts with solvent. Dry all parts with compressed air.

3. Inspect drive gear (9) shaft for a broken or chipped keyway.

4. Inspect drive gear and idler gear (8) shafts at the bushing points and seal area for rough surfaces and excessive wear.

5. Replace drive gear or idler gear if the shaft in the bushing area diameter measures less than 0.748 in. (19.0 mm). A single gear may be replaced separately.

6. The drive gear and idler gear face should be free of excessive scoring and wear.

7. Replace drive gear or idler gear if gear width is less than 1.140 in. (29.96 mm).

8. Make sure that retaining rings are in the grooves on both sides of the gear for both the drive gear and idler gear.

9. Break sharp edges of gear teeth with emery cloth.

10. Replace backplate (7) and frontplate (14) if bushing inside diameters exceed 0.755 in. (19.2 mm). The bushings are not available as replacement items.

11. The face of the backplate and frontplate should be free of excessive scoring. Replace if any scoring exists to a depth of 0.0015 in. (0.038 mm).

12. Replace body (12) if the inside diameter of the gear pockets exceeds 1.713 in. (43.5 mm).

13. Make sure that both relief valve plugs are secure if they or the backplate are not being replaced.

Reassembly (Fig. 44)

1. If replacing the relief valve assembly (19), install ball, spring, shim, O–ring, and plug into the backplate. Hand tighten plug and then torque from 10 to 12 ft–lb (14 to 16 N–m).

2. Coat new O–ring lightly with petroleum jelly and install in groove on the frontplate.

3. Apply a thin coat of petroleum jelly to both gear pockets of the body. Install alignment pin into body.

4. Align matchmarks and slip body onto frontplate until alignment pin is engaged.

5. Dip idler gear and drive gear into clean hydraulic oil and slip into frontplate bushings.

6. Coat new O–ring lightly with petroleum jelly and install in groove on the backplate.

7. Install alignment pin into backplate.

8. Align matchmarks and slip backplate over gear shafts onto body until alignment pin is engaged.

9. Install and hand tighten cap screws. Torque in a crisscross pattern from 25 to 28 ft–lb (34 to 38 N–m).

10. Place washer (18) over the drive shaft into the frontplate housing. Apply a liberal coat of hydraulic oil to the oil seal. Install oil seal over the drive shaft being careful not to cut the rubber seal lips.

11. Place a 1–1/16 inch O.D. sleeve over the drive shaft and press the oil seal into the frontplate housing until the retaining ring groove appears.

12. Install retaining ring into the frontplate housing using the sleeve until the ring seats in the groove.

Cutting Reel Motor Service (Serial Number Above 290000000)

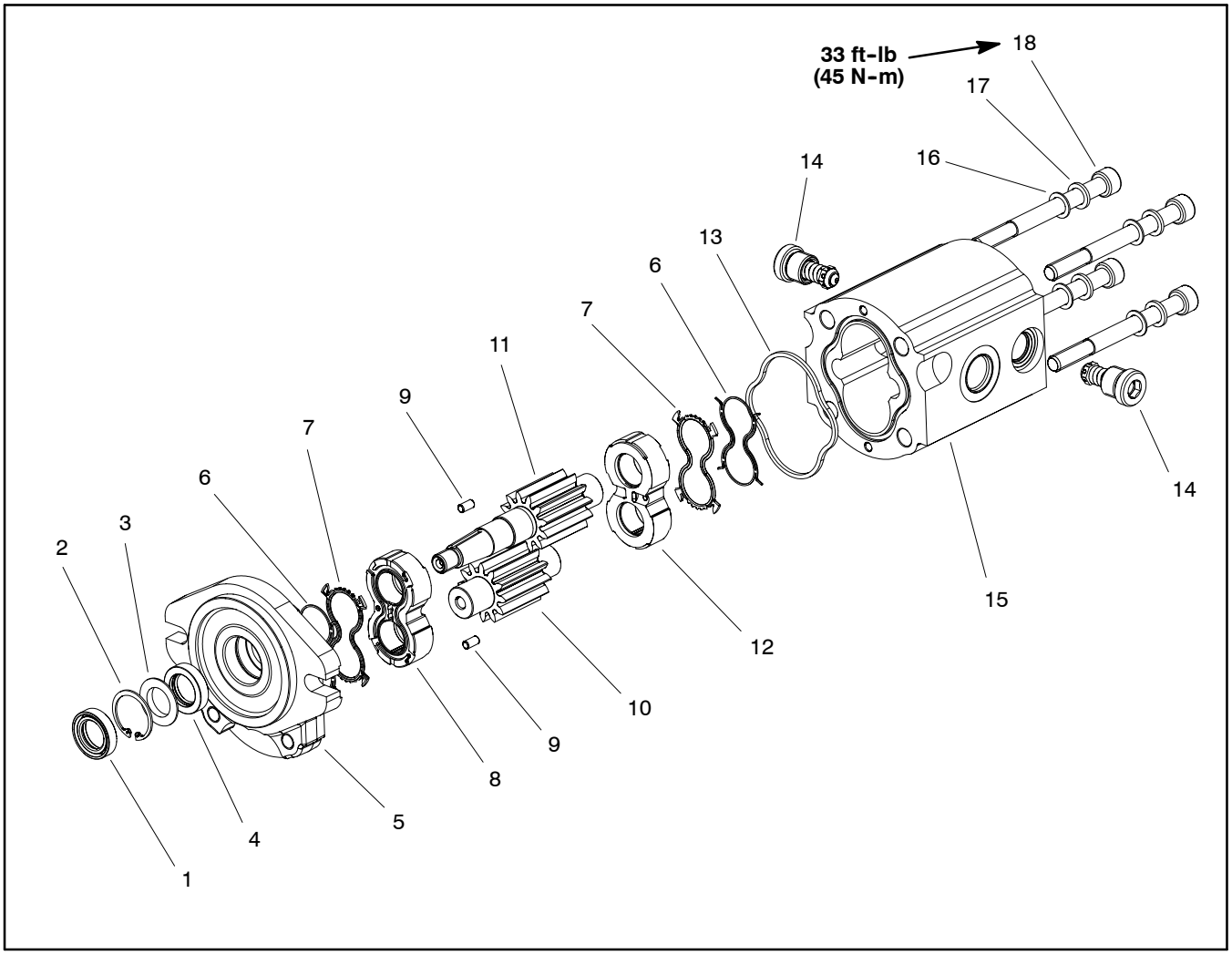


Figure 44.1

1. **Dust seal**
2. **Retaining ring**
3. **Flange washer**
4. **Shaft seal**
5. **Front flange**
6. **Pressure seal**
7. **Back-up gasket**
8. **Front wear plate**
9. **Dowel pin**
10. **Idler gear**
11. **Drive shaft**
12. **Rear wear plate**
13. **O-ring**
14. **Relief valve**
15. **Body**
16. **Washer (4 used)**
17. **Lock washer (4 used)**
18. **Cap screw (4 used)**

Disassembly (Fig. 44.1)

1. Plug motor ports and clean the outside of the motor thoroughly. After cleaning, remove plugs and drain any oil out of the motor.

2. Use a marker to make a **diagonal** line across the front flange and body for assembly purposes (Fig. 44.2).

IMPORTANT: Prevent damage when clamping the reel motor into a vise; clamp on the front flange only. Also, use a vise with soft jaws.

3. Clamp front flange of motor in a vise with soft jaws with the shaft end down.

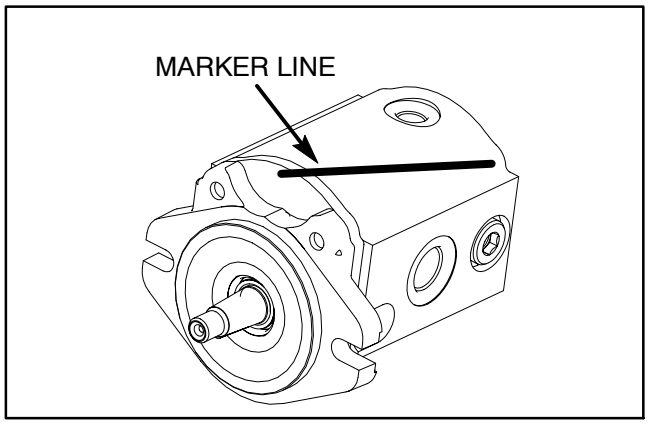


Figure 44.2

4. Loosen cap screws from the rear cover.

5. Remove motor from the vise. Turn motor so that the shaft end is facing down. Remove cap screws.

6. Carefully remove body. Lift body straight up to remove. Make sure the rear wear plate remains on the drive and idler gear shafts. Remove and discard O-rings from the body. Locate and retrieve dowel pins.

IMPORTANT: Note position of the open and closed side of the wear plates before removing. Also, identify wear plates (front and rear) with a marker for proper assembly.

7. Carefully remove rear wear plate, idler gear, drive shaft and front wear plate from the front flange.

8. Remove and discard back-up gaskets and pressure seals from wear plates.

9. Turn front flange over, with seal side up.

IMPORTANT: Make sure to not damage the front flange counter bore when removing the seals from the front flange.

10. Carefully remove dust seal, retaining ring, flange washer and shaft seal from the front flange (Fig. 44.3). Discard seals.

Inspection

1. Remove any nicks and burrs from all parts with emery cloth.

CAUTION

Use eye protection such as goggles when using compressed air.

2. Clean all parts with solvent. Dry all parts with compressed air.

3. Inspect drive gears and idler gears for the following (Fig. 44.4):

A. Gear shafts should be free of rough surfaces and excessive wear at bushing points and sealing areas. Scoring, rough surfaces or wear on gear shafts indicates need for replacement.

B. Gear teeth should be free of excessive scoring and wear. Any broken or nicked gear teeth must be replaced.

C. Inspect gear face edge for sharpness. Sharp edges of gears will mill into wear plates and, thus, must be replaced.

4. Inspect wear plates for the following:

A. Bearing areas should not have excessive wear or scoring.

B. Face of wear plates that are in contact with gears should be free of wear, roughness or scoring.

C. Thickness of wear plates should be equal.

5. Inspect front flange and rear cover for damage or wear.

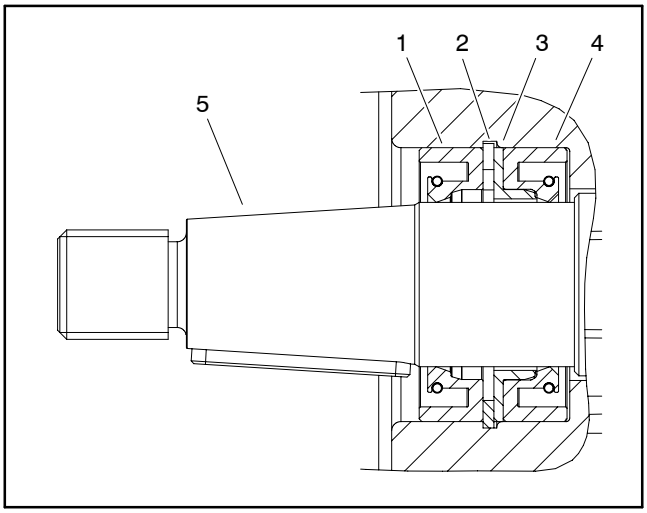


Figure 44.3

1. **Dust seal**
2. **Retaining ring**
3. **Flange washer**
4. **Shaft seal**
5. **Drive shaft**

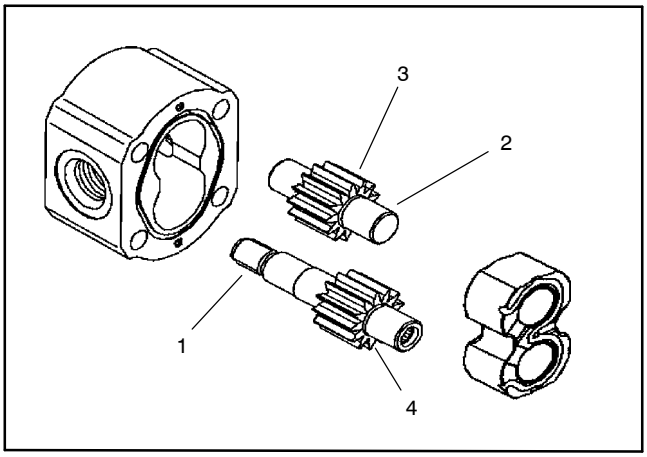


Figure 44.4

1. **Gear shaft spline**
2. **Gear shaft**
3. **Gear teeth**
4. **Gear face edge**

Assembly (Fig. 44.1)

NOTE: When assembling the motor, check the marker line on each part to make sure the parts are properly aligned during assembly.

1. Lubricate O−rings, pressure seals, back−up gaskets and wear plate grooves with a thin coat of petroleum jelly. Lubricate all other internal parts freely with clean hydraulic oil.

2. Install new seals into front flange (Fig. 44.3):

   A. Press shaft seal into front flange until it reaches the bottom of the bore.

   B. Install flange washer into front flange and then install retaining ring into the groove of the front flange.

   C. Install new dust seal into front flange.

3. Place front flange, seal side down, on a flat surface.

4. Install the pressure seals, flat side outward, into the grooves in the wear plates. Follow by carefully placing the backup gaskets, flat side outward, between the pressure seals and the grooves in the wear plate.

5. Apply a light coating of petroleum jelly to the exposed side of the front flange.

6. Lubricate the drive shaft with clean hydraulic oil. Insert the drive end of the drive shaft through the wear plate with the pressure seal side down and the open side of the pressure seal pointing to the inlet side of the motor. Carefully install shaft into front flange.

7. Lubricate the idler gear shaft with clean hydraulic oil. Install idler gear shaft into the remaining position in the front wear plate. Apply a light coating of clean hydraulic oil to gear faces.

8. Install rear wear plate with pressure seal side up and open side of the pressure seal pointing to the inlet side of the motor.

9. Apply a light coating of petroleum jelly to new O−ring and O−ring groove in the body. Install new O−ring to the body.

10. Install locating dowel pins in body. Align marker line on the body and front flange.

IMPORTANT: Do not dislodge seals during installation.

11. Gently slide the body onto the assembly. Firm hand pressure should be sufficient to engage the dowel pins.

12. Install the four (4) cap screws with washers and hand tighten.

IMPORTANT: Prevent damage when clamping the reel motor in a vise; clamp on the front flange only. Also, use a vise with soft jaws.

13. Place front flange of the motor into a vise with soft jaws and alternately torque the cap screws 33 ft−lb (45 N−m).

14. Remove motor from vise.

15. Place a small amount of clean hydraulic oil in the inlet of the motor and rotate the drive shaft away from the inlet one revolution. If any binding is noted, disassemble the motor and check for assembly problems.

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Hydraulic Manifold

Removal (Fig. 45)

1. Park the machine on a level surface, engage the parking brake, lower the cutting units, and stop the engine. Remove the key from the ignition switch.

CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.

2. Raise and remove hood to gain access to the hydraulic manifold.

NOTE: The ports on the manifold are marked for easy identification of components. Example: R1 is the reel circuit relief valve and G1 is the test gauge connection port. (See Hydraulic Schematics to identify the function of the hydraulic lines and cartridge valves at each port location).

3. If necessary, the hydraulic manifold can be removed (Figure 45):

A. Disconnect solenoid valve and backlap switch electrical connectors.

B. Clean manifold and hydraulic connections. Disconnect hydraulic lines. Label all connections for reassembly.

C. Allow hydraulic lines to drain into a suitable container. Put caps or plugs on disconnected hoses and fittings to prevent contamination.

D. Remove two flange head screws that secure bottom of hydraulic manifold to the mounting bracket.

E. Support hydraulic manifold and remove flange head screw that secures hydraulic manifold to the cylinder support bracket. Remove hydraulic manifold from the machine.

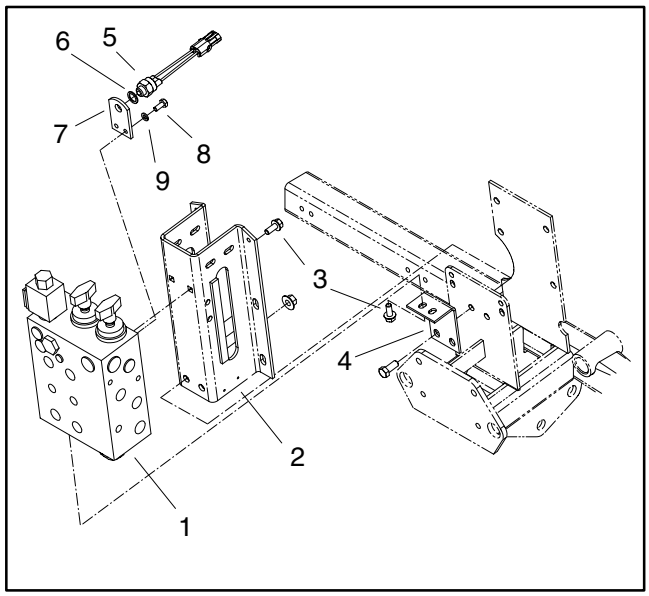

Figure 45

1. **Hydraulic manifold**
2. **Cylinder support bracket**
3. **Flange head screw**
4. **Mounting bracket**
5. **Backlap switch**
6. **Flat washer**
7. **Switch bracket**
8. **Cap screw**
9. **Lock washer**

Installation (Fig. 45)

1. Secure hydraulic manifold to the cylinder support bracket and the mounting bracket with three flange head screws.

2. Make sure all hydraulic connections, ports, and fittings are clean.

3. Remove caps or plugs that were put on any hydraulic lines or fittings during disassembly.

4. Correctly connect hydraulic lines to the manifold. Tighten all hydraulic fittings and connections.

5. Reconnect solenoid valve and backlap switch electrical connectors.

6. Install hood.

7. Follow Hydraulic System Start–up procedures.

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Hydraulic Manifold Service (Serial Number Below 290000000)

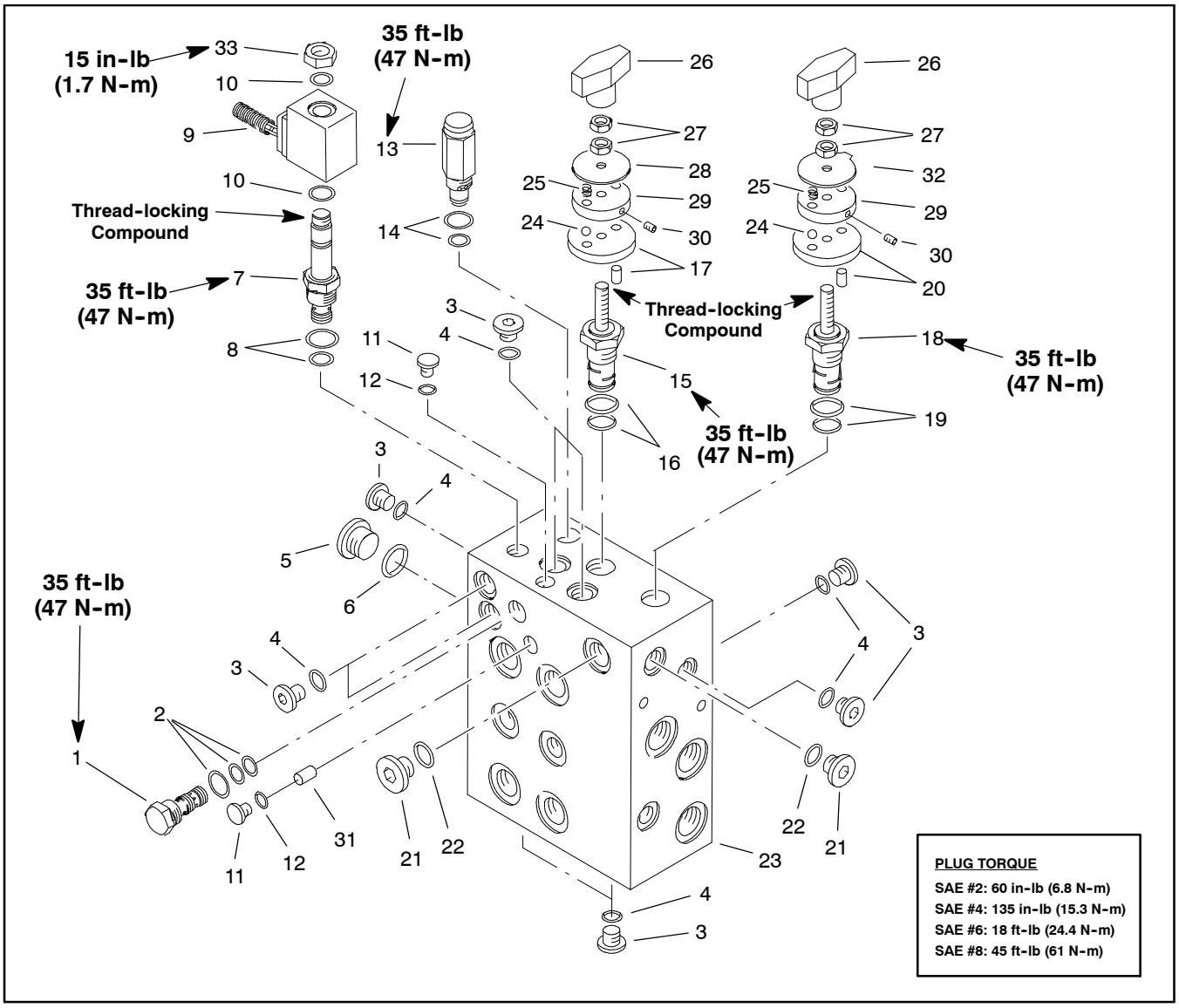

Figure 46

1. Logic cartridge (port LC1)
2. Seal kit
3. Plug (SAE #4)
4. O-ring
5. Plug (SAE #8)
6. O-ring
7. Solenoid cartridge (port S1)
8. Seal kit
9. Solenoid valve coil
10. Solenoid seal
11. Plug (SAE #2)
12. O-ring
13. Reel relief cartridge (port R1)
14. Seal kit
15. Reel speed cartridge (port FC1)
16. Seal kit
17. Locating plate
18. Backlap cartridge (port MD1)
19. 4-way seal kit
20. Locating plate
21. Plug (SAE #6)
22. O-ring
23. Manifold body
24. Ball
25. Spring
26. Knob
27. Jam nut
28. Indicator plate
29. Detent plate
30. Socket head screw
31. Orifice plug
32. Indicator plate
33. Nut

NOTE: The ports on the manifold are marked for easy identification of components. Example: P1 is the gear pump connection port and S1 is the location for the solenoid cartridge (See Hydraulic Schematics to identify the function of the hydraulic lines and cartridge valves at each port).

Hydraulic Manifold Service

1. Make sure the manifold is clean before removing the cartridge valve.

2. If solenoid cartridge is being serviced, remove nut securing solenoid to the cartridge valve. Carefully slide solenoid off the valve.

3. If reel speed control cartridge valve or backlap cartridge valve is being serviced, remove knob assembly:

   A. Unscrew and remove knob. Remove both jam nuts.

   B. Slide off indicator plate being careful not to lose springs or balls. Remove both springs and balls from detent plate.

   C. Loosen set screw and slide detent plate from the spool valve stem.

   D. Remove locating plate with pin from spool valve.

IMPORTANT: Use care when handling the cartridge valve. Slight bending or distortion of the stem tube can cause binding and malfunction.

4. Remove cartridge valve with a deep socket wrench. Note correct location for o–rings, sealing rings, and backup rings. Remove and discard seal kit.

5. Visually inspect the manifold port for damage to the sealing surfaces, damaged threads, and contamination.

6. Visually inspect cartridge valve for damaged sealing surfaces and contamination.

   A. Contamination may cause valves to stick or hang up. Contamination can become lodged in small valve orifices or seal areas causing malfunction.

   B. If valve sealing surfaces appear pitted or damaged, the hydraulic system may be overheating or there may be water in the system.

CAUTION

Use eye protection such as goggles when using compressed air.

7. Clean cartridge valve using clean mineral spirits. Submerge valve in clean mineral spirits to flush out contamination. Particles as fine as talcum powder can affect the operation of high pressure hydraulic valves. If cartridge design allows, use a wood or plastic probe to push the internal spool in and out 20 to 30 times to flush out contamination. Be extremely careful not to damage cartridge. Use compressed air for cleaning.

8. Reinstall the cartridge valve:

   A. Lubricate new seal kit components with clean hydraulic oil and install on valve. The o–rings, sealing rings, and backup rings must be arranged properly on the cartridge valve for proper operation and sealing.

   IMPORTANT: Use care when handling the valve cartridge. Slight bending or distortion of the stem tube can cause binding and malfunction.

   B. Thread cartridge valve carefully into correct manifold port. The valve should go in easily without binding.

   C. Torque cartridge valve using a deep socket to 35 ft–lb (47 N–m).

9. If solenoid cartridge was removed: carefully install solenoid coil to the cartridge valve making sure that seal is placed on both sides of the coil. Apply medium strength thread–locking compound to the threads of the valve. Torque nut to 15 in–lb (1.7 N–m).

10. If reel speed control cartridge valve or backlap cartridge valve was removed: reinstall knob assembly to cartridge stem.

   A. Install locating plate so that the pin seats into the locating hole.

   B. Turn the threaded spool valve stem carefully clockwise until it stops.

   C. Place detent plate counterbore down and thread detent plate down onto the valve stem until it is stopped by the locating plate. Turn detent plate back counterclockwise 1/4 turn.

   D. Center one detent plate hole over a locating plate indentation. Drop a ball into each hole and then drop a spring into each hole.

   E. Place indicator plate over the detent plate:

      On backlap valve, make sure the arrow points to the right at 45º.

      On reel speed control valve, make sure the arrow points directly at the number 1 on the locating plate.

   F. While pushing down on the indicator plate and compressing the springs, install a jam nut onto the valve stem. While tightening the set screw, tighten jam nut at the same time using a 7/16“ wrench.

   G. Thread second jam nut all the way down the valve stem. Apply medium strength thread–locking compound to the valve stem threads. Screw knob all the way down until it contacts the upper jam nut.

H. On backlap valve, turn knob counterclockwise so the arrow is 90° with the back of the manifold body. Simultaneously tighten upper jam nut and turn knob so it is tight and the arrow is pointing 45° to the right in line with the indicator plate.

I. On reel speed control valve, turn knob counterclockwise until the arrow points at the number ”5”. Simultaneously tighten upper jam nut and turn knob so it is tight and the arrow is pointing at the number ”1” on the locating plate.

11. After reassembly, if problems still exist, remove valve and clean again or replace valve.

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Hydraulic Manifold Service (Serial Number Above 290000000)

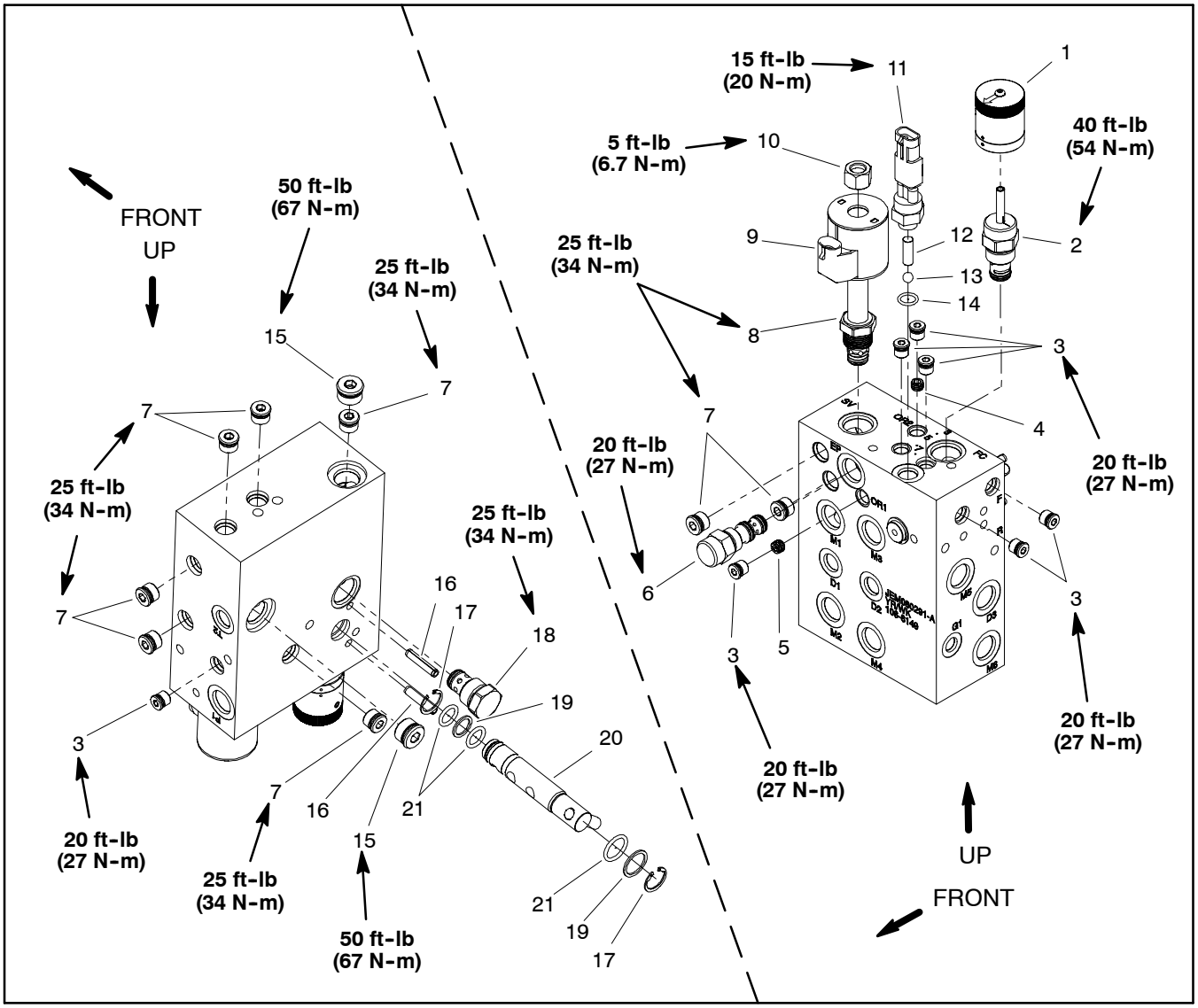

Figure 46.1

1. Handle assembly
2. Flow control cartridge (port FC)
3. #4 zero leak plug with O-ring
4. Orifice 0.076 (port OR2)
5. Orifice (port OR1)
6. Pilot directional element (port EP)
7. #6 zero leak plug with O-ring
8. Solenoid relief valve (port SV)
9. Solenoid coil
10. Nut
11. Backlap switch
12. Dowel pin
13. Ball
14. O-ring
15. #8 zero leak plug with O-ring
16. Spring pin
17. Retaining ring
18. Check valve
19. Back-up ring
20. Spool
21. O-ring

NOTE: The ports on the manifold are marked for easy identification of components. Example: P1 is the gear pump connection port and SV is the location for the solenoid cartridge (See Hydraulic Schematics to identify the function of the hydraulic lines and cartridge valves at each port).

NOTE: The hydraulic manifold shown in Figure 46.1 uses several zero leak plugs. These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero leak plugs also have an O-ring as a secondary seal. If zero leak plug removal is necessary, lightly rap the plug head using a punch and hammer before using an allen wrench to remove the plug: the impact will allow plug removal with less chance of damage to the socket head of the plug.

Hydraulic Manifold Service

1. Make sure the manifold is thoroughly cleaned before removing any cartridge valve.

2. If solenoid cartridge valve is being serviced, remove nut securing solenoid coil to the cartridge valve. Carefully slide solenoid coil off the valve.

3. If flow control cartridge valve is being serviced, remove rotary handle from valve stem (Fig. 46.2):

A. Loosen two (2) set screws that secure handle cap.

B. Remove screw and then lift handle cap from valve.

C. Locate and retrieve detent pin, compression spring, bushing and lip seal. The sleeve bearing should stay in the cap.

D. Loosen two (2) set screws that secure handle base to flow control valve and remove base.

CAUTION

Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.

IMPORTANT: Use care when removing cartridge valves. Slight bending or distortion of the stem tube can cause binding and malfunction. Make sure that deep well socket fully engages the valve base.

4. Using a deep well socket, remove cartridge valve from manifold. Note correct location of O−rings, sealing rings and backup rings. Remove and discard seal kit from valve.

IMPORTANT: Before removing mow/backlap spool from mow manifold, remove backlap switch, dowel pin and ball.

5. If necessary, remove mow/backlap spool from mow manifold:

A. Remove backlap switch from mow manifold before removing mow/backlap spool. Remove dowel pin and ball from manifold port after switch is removed. Remove and discard O−ring from switch.

B. Remove lower retaining ring from mow/backlap spool. Raise mow/backlap spool to allow access to retaining ring on upper end of spool. Remove upper retaining ring.

C. Push spool down until O−ring and back−up ring are exposed on bottom of mow manifold. Remove lower O−ring and back−up ring from spool.

D. Pull spool up and out of mow manifold. Remove O−rings and back−up ring from spool.

E. Discard removed O−rings and back−up rings.

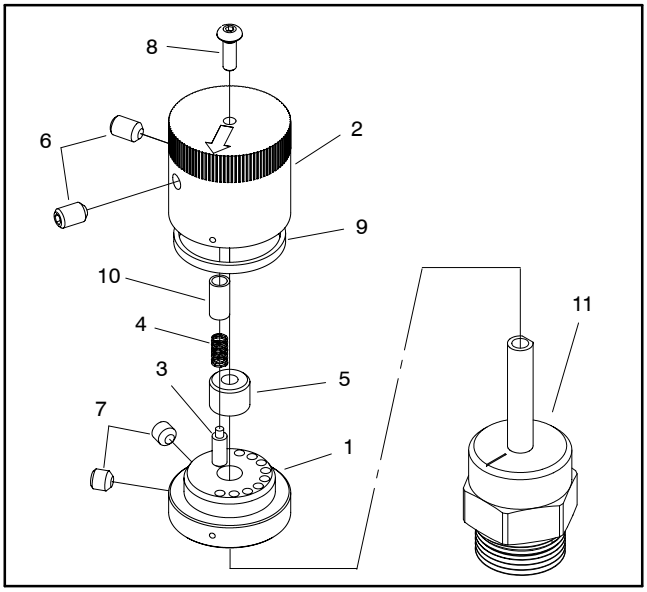

Figure 46.2

1. **Handle base**
2. **Handle cap**
3. **Detent pin**
4. **Compression spring**
5. **Bushing**
6. **Set screw (2 used)**
7. **Set screw (2 used)**
8. **Screw**
9. **Lip seal**
10. **Sleeve bearing**
11. **Flow control valve**

6. Visually inspect the manifold port for damage to the sealing surfaces, damaged threads and contamination.

7. Visually inspect cartridge valve for damaged sealing surfaces and contamination.

A. Contamination may cause valves to stick or hang up. Contamination can become lodged in small valve orifices or seal areas causing valve malfunction.

B. If valve sealing surfaces appear pitted or damaged, the hydraulic system may be overheating or there may be water in the system.

CAUTION

Use eye protection such as goggles when using compressed air for cartridge valve cleaning.

CAUTION

Abrupt movement of internal spools can cause stored fluid to be released suddenly.

8. Clean cartridge valve by submerging valve in clean mineral spirits to flush out contamination. Particles as fine as talcum powder can affect the operation of high pressure hydraulic valves. If cartridge design allows, use a wood or plastic probe to push the internal spool in and out 20 to 30 times to flush out contamination. Be extremely careful not to damage cartridge. Use compressed air for cleaning.

9. If mow/backlap spool was removed from mow manifold, install spool:

   A. Install O−rings and back−up ring to upper grooves on spool. Apply a light coating of grease to O−rings.

   B. Carefully push spool down into mow manifold port until lower O−ring and back−up ring groove is exposed on bottom of manifold. Install lower O−ring and back−up ring to spool. Apply a light coating of grease to O−ring.

   C. Carefully raise mow/backlap spool until upper retaining ring groove on spool is exposed on top of manifold. Install upper retaining ring.

   D. Push mow/backlap spool down and install lower retaining ring to spool.

   E. If handle was removed from spool, position spool so handle location of spool is between stop pins. Apply Loctite 603 Retaining Compound (or equivalent) to threads on handle and install handle into spool.

   F. Place ball and dowel pin in backlap switch manifold port. Install new O−ring onto backlap switch. Thread backlap switch into port and torque 15 ft−lb (20 N−m).

10. Reinstall cartridge valve into manifold:

   A. Lubricate new seal kit components with clean hydraulic oil and install on valve. The O−rings, sealing rings and backup rings must be arranged properly on the cartridge valve for proper operation and sealing.

   IMPORTANT: Use care when installing cartridge valves. Slight bending or distortion of the stem tube can cause binding and malfunction. Make sure that deep well socket fully engages the valve base.

   B. Lubricate threads of cartridge valve with clean hydraulic oil. Thread cartridge valve carefully into correct manifold port. The valve should go in easily without binding.

   C. Torque cartridge valve using a deep well socket to values identified in Figure 46.1.

11. If solenoid coil was removed, install coil onto solenoid valve:

   A. Carefully install coil onto the cartridge valve.

   B. Install nut and torque nut to 5 ft−lb (6.7 N−m).

12. If flow control cartridge valve was removed, install rotary handle to valve stem (Fig. 46.2):

   A. Place handle base on flow control valve and position alignment mark on base with number 1 on manifold. Secure base with two (2) set screws. Apply a light coating of grease to chamfer on top of base to ease seal installation.

   B. Make sure that sleeve bearing is in handle cap. If necessary, press sleeve bearing into cap. Install lip seal on cap with seal lip facing down.

   C. Place bushing onto cartridge valve stem. Use a small amount of grease to keep bushing toward the top of the valve stem.

   D. Place compression spring and detent pin into handle cap. Use a small amount of grease to hold detent pin in place.

   E. Make sure that flow control cartridge is closed by rotating valve stem fully clockwise. During handle installation, DO NOT rotate valve stem or speed adjustment will be incorrect.

   F. Press handle cap onto valve stem with arrow on cap pointing to number 9 on manifold. Make sure that detent pin and spring stay positioned in cap.

   G. While pressing on the cap to keep the lip seal in place, rotate cap in a clockwise direction until the arrow on the cap aligns with number 1 on the manifold. By rotating the cap clockwise, the valve will remain closed. Install screw to retain cap.

   H. Make sure that alignment marks on cap and base are in line and that arrow on cap is pointing to number 1 on manifold. Tighten two (2) set screws to secure handle cap.

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3 Wheel Drive Selector Valve

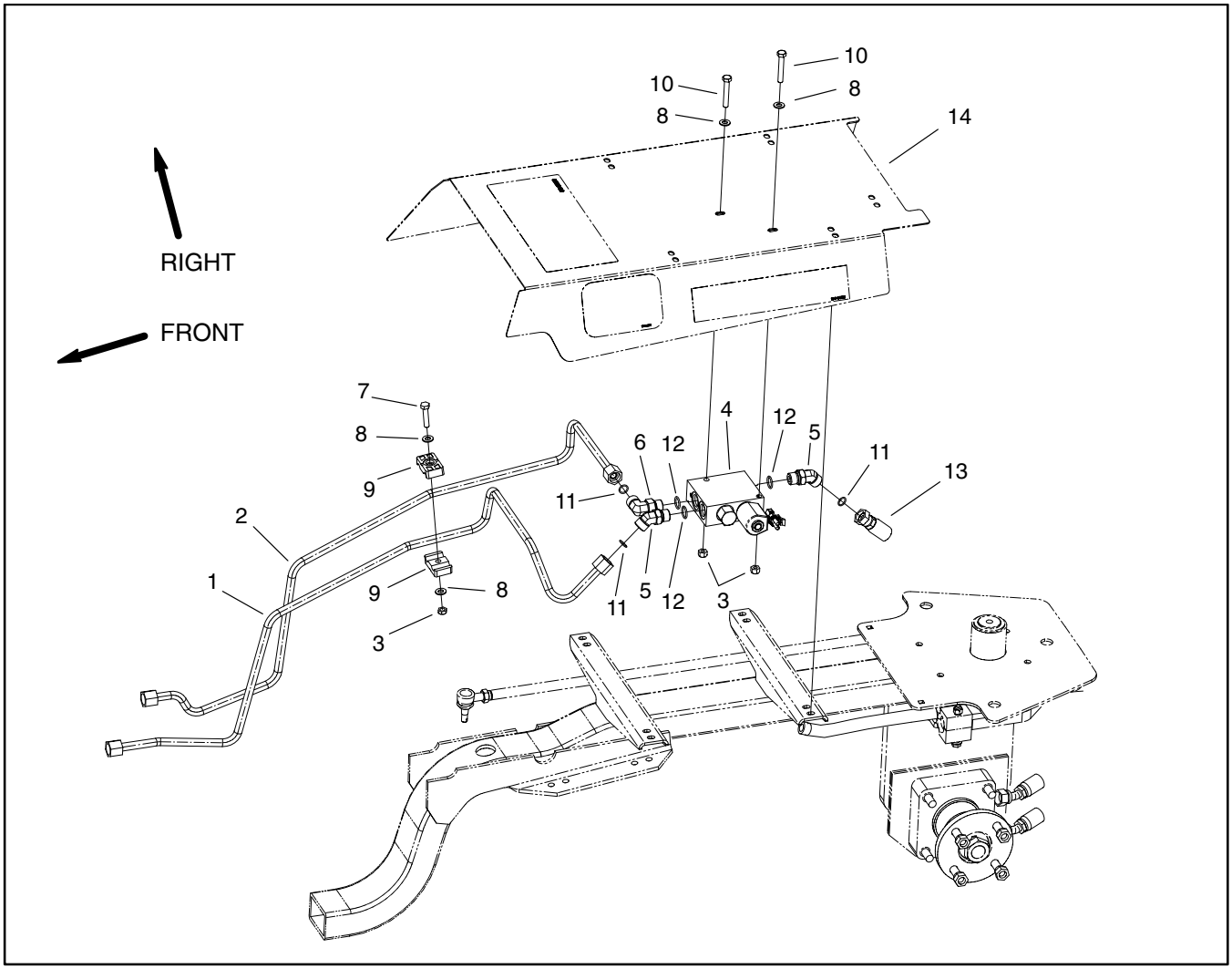

Figure 47

1. **Forward hydraulic tube**
2. **Reverse hydraulic tube**
3. **Lock nut**
4. **3WD selector valve**
5. **Hydraulic fitting**
6. **90º hydraulic fitting**
7. **Cap screw**
8. **Flat washer**
9. **Tube clamp**
10. **Cap screw**
11. **O–ring**
12. **O–ring**
13. **Hydraulic hose**
14. **Frame skirt**

If the optional 3 Wheel Drive Kit has been installed, the 3WD selector valve removal and installation procedure is as follows.

Removal (Fig. 47)

1. Park the machine on a level surface, engage the parking brake, lower the cutting units, and stop the engine. Remove the key from the ignition switch.

CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.

2. Clean selector valve and hydraulic fittings.

3. Put caps or plugs on any hydraulic lines or fittings left open or exposed. Put labels on disconnected hydraulic lines and hoses for proper reassembly.

4. Loosen lock nut and cap screw that secure tube clamp so the hydraulic tubes can be moved.

5. Disconnect two hydraulic hoses and two hydraulic tubes from hydraulic fittings on selector valve. Allow hydraulic oil to drain from hoses and tubes into a suitable container.

6. Disconnect electrical connector from solenoid valve on selector valve.

7. Remove cap screws and flat washers that secure selector valve to frame skirt.

8. Remove selector valve from machine.

9. Remove fittings and O–rings from selector valve. Discard O–rings.

Installation (Fig. 47)

1. Install hydraulic fittings and new O–rings into selector valve.

2. Position selector valve to the machine. Secure selector valve to the frame skirt with two cap screws and flat washers.

3. Remove caps or plugs that were put on any hydraulic lines or fittings during disassembly.

4. Install hydraulic tubes and hoses to hydraulic fittings on selector valve and tighten fittings.

5. Install electrical connector to solenoid valve on selector valve.

6. Tighten lock nut and cap screw so the tube clamp will prevent movement of the hydraulic tubes.

7. Follow Hydraulic System Start–up procedures.

3 Wheel Drive Selector Valve Service

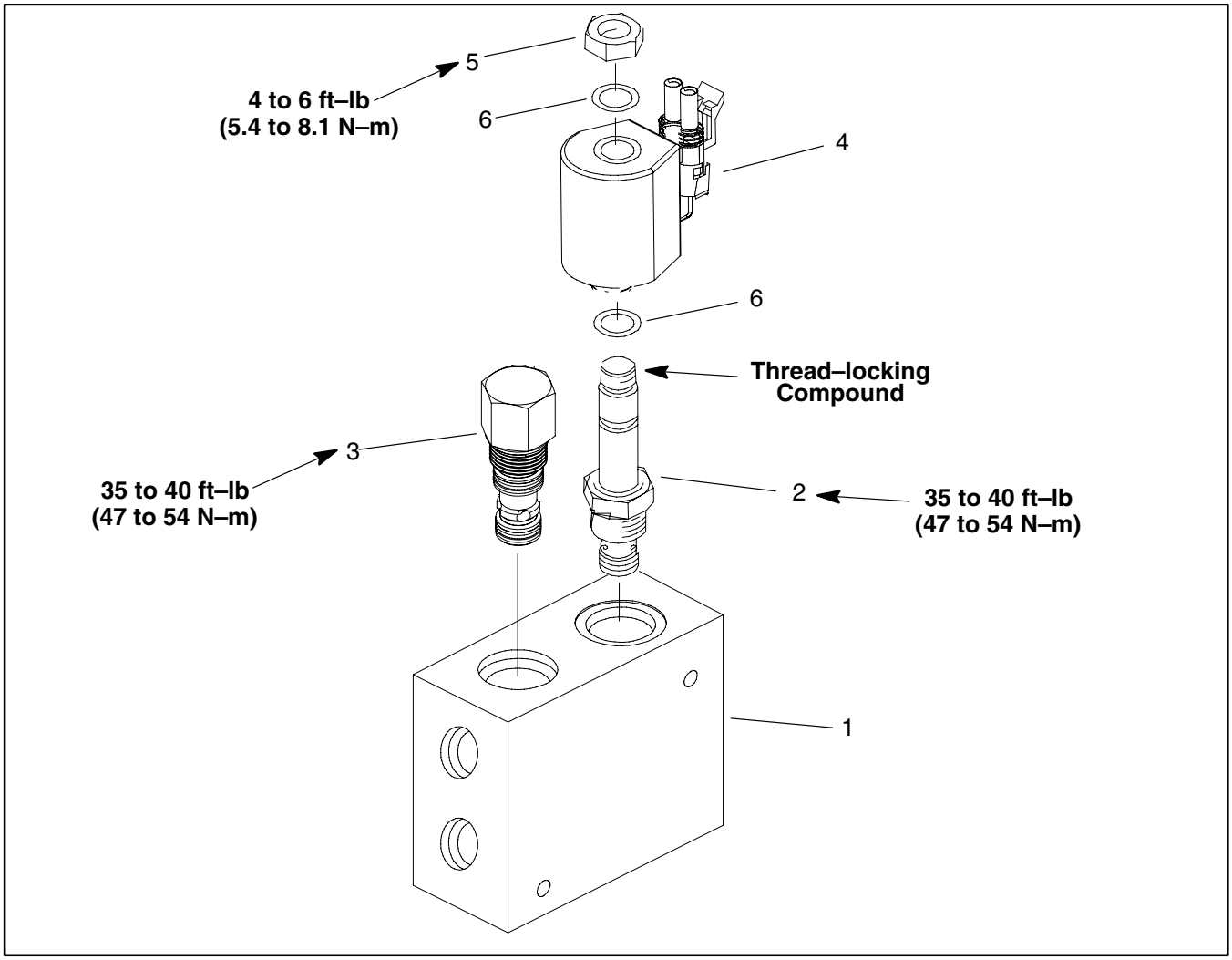

Figure 48

1. Selector Valve manifold
2. Solenoid valve
3. Pilot operated directional valve
4. Solenoid coil
5. Nut
6. O–ring

If the optional 3 Wheel Drive Kit has been installed, the 3WD selector valve service procedure is as follows.

Selector Valve Service

1. Make sure the manifold is clean before removing the cartridge valve.

2. If solenoid cartridge is being serviced, remove nut securing solenoid to the cartridge valve. Carefully slide solenoid off the valve.

IMPORTANT: Use care when handling the cartridge valve. Slight bending or distortion of the stem tube can cause binding and malfunction.

3. Remove cartridge valve with a deep socket wrench. Note correct location for o–rings, sealing rings, and backup rings. Remove and discard seal kit.

4. Visually inspect the manifold port for damage to the sealing surfaces, damaged threads, and contamination.

5. Visually inspect cartridge valve for damaged sealing surfaces and contamination.

   A. Contamination may cause valves to stick or hang up. Contamination can become lodged in small valve orifices or seal areas causing malfunction.

   B. If valve sealing surfaces appear pitted or damaged, the hydraulic system may be overheating or there may be water in the system.

CAUTION

Use eye protection such as goggles when using compressed air.

6. Clean cartridge valve using clean mineral spirits. Submerge valve in clean mineral spirits to flush out contamination. Particles as fine as talcum powder can affect the operation of high pressure hydraulic valves. If cartridge design allows, use a wood or plastic probe to push the internal spool in and out 20 to 30 times to flush out contamination. Be extremely careful not to damage cartridge. Use compressed air for cleaning.

7. Reinstall the cartridge valve:

   A. Lubricate new seal kit components with clean hydraulic oil and install on valve. The o–rings, sealing rings, and backup rings must be arranged properly on the cartridge valve for proper operation and sealing.

   IMPORTANT: Use care when handling the cartridge valve. Slight bending or distortion of the stem tube can cause binding and malfunction.

   B. Thread cartridge valve carefully into correct manifold port. The valve should go in easily without binding.

   C. Torque cartridge valve using a deep socket from 35 to 40 ft–lb (47 to 54 N–m).

8. If solenoid cartridge was removed:

   A. Carefully install solenoid coil to the cartridge valve making sure that seal is placed on both sides of the coil.

   B. Apply medium strength thread–locking compound to the threads of the valve.

   C. Torque nut from 4 to 6 ft–lb (5.4 to 8.1 N–m).

9. After reassembly, if problems still exist, remove valve and clean again or replace valve.

Front Lift Cylinder

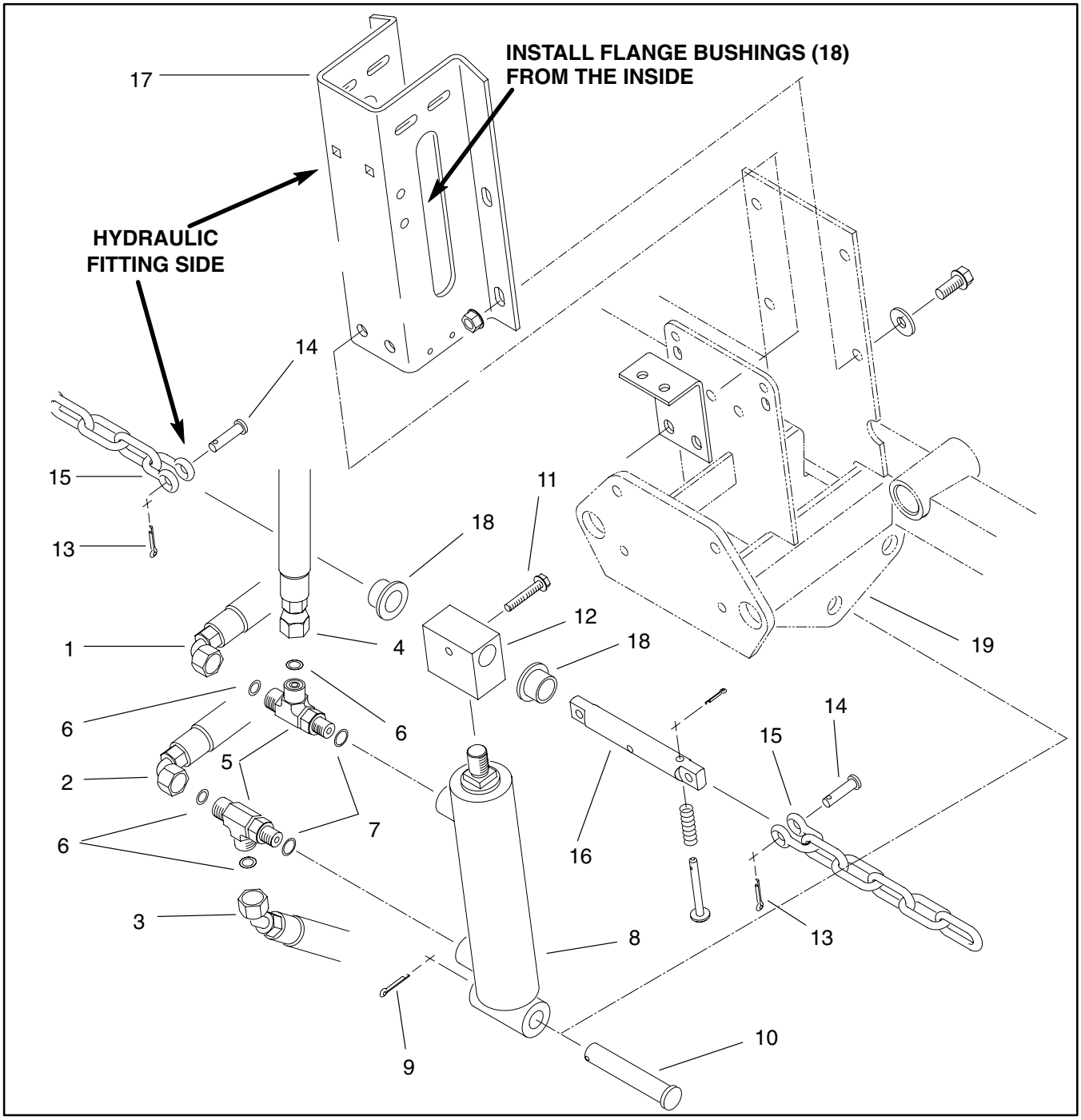

Figure 49

1. Hydraulic hose
2. Hydraulic hose
3. Hydraulic hose
4. Hydraulic hose
5. Hydraulic tee fitting
6. O–ring
7. O–ring
8. Lift cylinder
9. Cotter pin
10. Clevis pin
11. Flange head screw
12. Lift hub
13. Cotter pin
14. Clevis pin
15. Lift chain clevis
16. Cylinder guide pin
17. Cylinder support bracket
18. Flange bushing
19. Valve mount bracket

Removal (Fig. 49)

1. Park the machine on a level surface, engage the parking brake, lower the cutting units, and stop the engine. Remove the key from the ignition switch.

CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.

2. Remove cutting units from front lift arms (see Traction Unit Operator's Manual).

3. Raise and remove hood to get access to the front lift cylinder (see Traction Unit Operator's Manual). Label all connections for reassembly.

4. Disconnect hydraulic hoses (1, 2, 3, and 4) from hydraulic fittings (5). Allow hoses to drain into a suitable container.

5. Put caps or plugs on disconnected hoses and fittings to prevent contamination.

6. Remove hydraulic fittings (5) and O–rings (7) from the lift cylinder (8).

7. Remove cotter pin (9) from the clevis pin (10). Pull clevis pin from the lift cylinder and frame.

8. Remove flange head screw (11) from cylinder guide pin (16) and lift hub (12). Remove cotter pin (13) and clevis pin (14) from the lift chain clevis (15) that is on the hydraulic fitting side of the cylinder support bracket (17).

9. Support lift cylinder and slide cylinder guide pin (16) from the lift hub (12).

10. Reach up from the bottom and rotate lift cylinder so the bottom port comes out of the slot in the frame. Drop lift cylinder down and out from the frame.

11. Remove flange bushings (18) from the cylinder support bracket (17).

12. Remove lift hub from the lift cylinder shaft.

Installation (Fig. 49)

1. Thread lift hub onto lift cylinder and tighten fully.

2. Position lift cylinder inside the cylinder support bracket and valve mount bracket. Make sure the ports of the lift cylinder face the hydraulic fitting side of the cylinder support bracket.

3. Align lift cylinder mounting hole with holes at bottom of the valve mount bracket. Slide clevis pin through holes and secure clevis pin with cotter pin.

4. Align lift hub holes with the slots on the cylinder support bracket. Apply grease to flange bushings and install bushings into the cylinder support bracket slots.

5. Make sure flange bushings are aligned with the lift hub holes. Slide cylinder guide pin through the cylinder support bracket, flange bushings, and lift hub.

6. Align hole in cylinder guide pin to lift hub hole. Secure guide pin by installing flanged head screw fully.

7. Secure lift chain clevis (15) to the cylinder guide pin with clevis pin and cotter pin.

8. Remove caps and plugs from disconnected hoses and fittings.

9. Install O–rings and hydraulic fittings into the lift cylinder.

10. Connect hydraulic hoses to hydraulic fittings on lift cylinder. Tighten hose connections.

11. Install hood.

12. Install cutting units to front lift arms (see Traction Unit Operator's Manual).

13. Follow Hydraulic System Start–up procedures.

Front Lift Cylinder Service

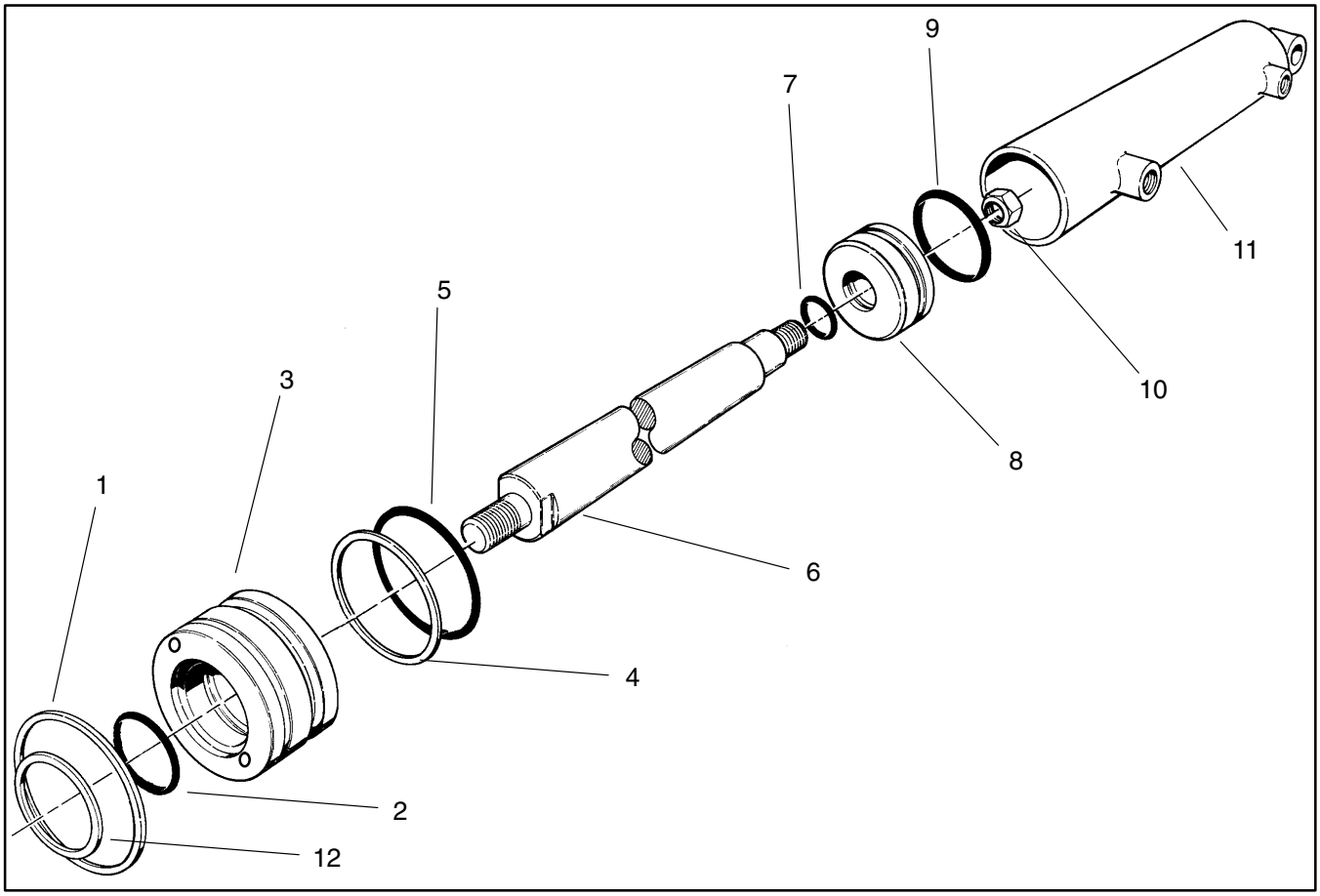

Figure 50

1. Retaining ring
2. O–ring
3. Head
4. Backup washer
5. O–ring
6. Shaft
7. O–ring
8. Piston
9. Uni–ring
10. Lock nut
11. Barrel
12. Dust seal

Disassembly (Fig. 50)

1. Remove oil from the cylinder into a drain pan by **slowly** pumping the cylinder shaft (6). Plug both ports and clean the outside of the lift cylinder.

IMPORTANT: Prevent damage when clamping the lift cylinder into a vise; clamp on the pivot only. Do not close vise enough to distort barrel.

2. Mount lift cylinder in a vise so that the shaft end tilts up slightly. Remove and discard dust seal (12).

3. Rotate head (3) with a spanner wrench and remove retaining ring as shown in Figure 51.

4. Grasp end of shaft; extract shaft, head, and piston (8) by carefully twisting and pulling on the shaft.

IMPORTANT: Do not clamp vise jaws against shaft surface. Protect shaft surface before mounting in vise.

5. Mount shaft securely in a vise by clamping vise on the flats of the shaft. Remove locknut (10) and piston from the shaft. Slide head from the shaft.

6. Remove and discard O–ring (7) and uni–ring (9) from the piston. Remove and discard both O–rings (2 and 5) and backup washer (4) from the head.

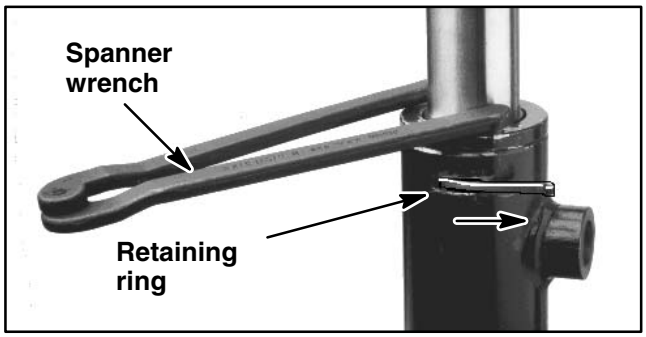

Figure 51

Inspection

CAUTION

Use eye protection such as goggles when using compressed air

1. Wash all parts in solvent. Dry parts with compressed air.

2. Inspect internal surface of barrel for deep scratches, out–of–roundness, and bending. Replace if worn or damaged.

3. Inspect head, shaft, and piston for excessive pitting, scoring, and wear. Replace any worn or damaged parts.

Reassembly (Fig. 50)

1. Coat all O–rings, uni–ring, and backup washer lightly with hydraulic oil. Install new O–ring and uni–ring to the piston. Install O–rings and backup washer to the head.

IMPORTANT: Do not clamp vise jaws against shaft surface. Protect shaft surface before mounting in vise.

2. Mount shaft securely in a vise by clamping vise on the ends of the shaft. Slide head onto the shaft. Install piston and locknut onto the shaft and tighten lock nut.

3. Remove shaft from vise.

IMPORTANT: Prevent damage when clamping the barrel into a vise; clamp on the pivot end only. Do not close vise enough to distort barrel.

4. Mount barrel in a vise so that the shaft end tilts up slightly.

5. Coat all internal lift cylinder parts with a light coat of hydraulic oil. Slide piston, shaft, and head assembly into barrel being careful not to damage the seals.

6. Secure head in barrel by installing retaining ring. Align key slot in head with the access groove in the barrel. Rotate head clockwise as far as the retaining ring will allow. The offset end of the retaining ring will be against the left side of the barrel groove as shown in Figure 52.

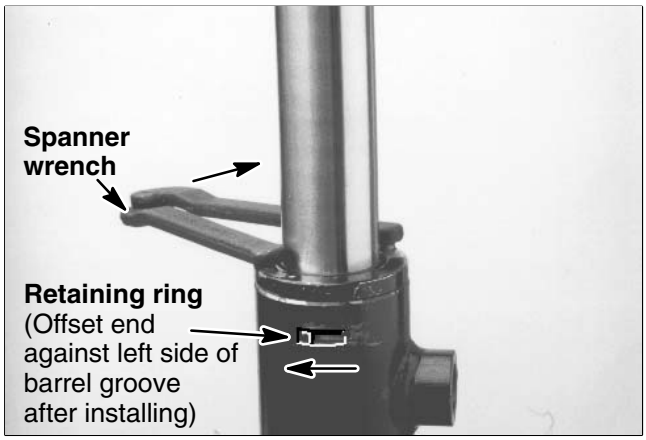

Figure 52

Rear Lift Cylinder

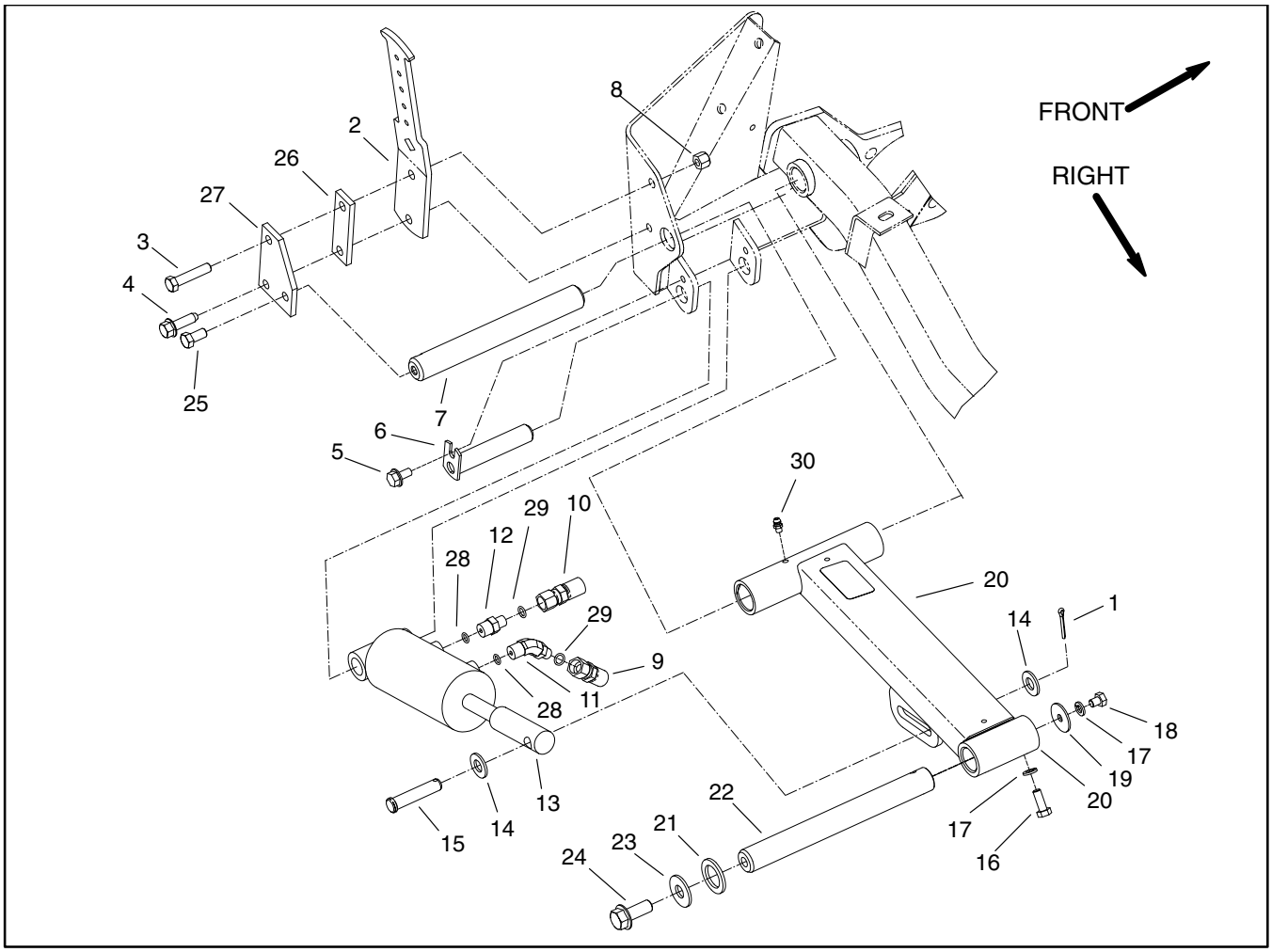

Figure 53

1. Cotter pin
2. Tension spring arm
3. Cap screw
4. Thread forming screw
5. Washer head screw
6. Ram pivot pin
7. Lift arm pivot shaft
8. Lock nut
9. Hydraulic hose
10. Hydraulic hose
11. 45º hydraulic fitting
12. Hydraulic fitting
13. Rear lift cylinder
14. Flat washer
15. Clevis pin
16. Cap screw
17. Lock washer
18. Cap screw
19. Flat washer
20. Rear lift arm
21. Thrust washer
22. Cutting unit pivot shaft
23. Flat washer
24. Flange head screw
25. Cap screw
26. Spacer
27. Reinforcement plate
28. O–ring
29. O–ring
30. Grease fitting

Removal (Fig. 53)

1. Park the machine on a level surface, engage the parking brake, lower the cutting units, and stop the engine. Remove the key from the ignition switch.

2. Remove cutting unit from rear lift arm (see Traction Unit Operator's Manual).

CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.

CAUTION

The rear lift cylinder is located near the muffler exhaust pipe. To avoid possible burns, allow the exhaust pipe to cool before working on the rear lift cylinder.

3. Label all connections for reassembly. Disconnect both hydraulic hoses from hydraulic fittings on lift cylinder. Allow hoses to drain into a suitable container.

4. Put caps or plugs on disconnected hoses and fittings to prevent contamination.

5. Remove washer head screw (6) that secures ram pivot pin (6) to frame. Slide ram pivot pin from frame and lift cylinder.

6. Rotate lift cylinder while swinging the lift cylinder down from the frame, so the hydraulic fittings (11 and 12) clear the exhaust system.

7. Remove cotter pin (1) and flat washer (14) from clevis pin (15). Support lift cylinder and slide clevis pin with second flat washer out of the lift arm. Remove lift cylinder from machine.

8. Remove hydraulic fittings (11 and 12) and O–rings from the lift cylinder.

Installation (Fig. 53)

1. Coat new O–rings lightly with clean hydraulic oil. Install hydraulic fittings with new O–rings to the lift cylinder.

2. Position lift cylinder inside frame pivot supports. Install ram pivot pin and washer head screw.

3. Swing the lift cylinder up so the clevis is positioned at the lift arm slot. Slide a flat washer onto the clevis pin. Slide clevis pin through the lift cylinder clevis and the lift arm slot. Install remaining flat washer and then cotter pin onto the clevis pin.

4. Remove caps or plugs from disconnected hoses. Install hose connections onto hydraulic fittings. Tighten hydraulic hose fittings.

5. Install cutting unit to rear lift arm (see Traction Unit Operator's Manual).

6. Check and adjust rear carrier frame height (see Traction Unit Operator's Manual).

7. Follow Hydraulic System Start–up procedures.

Rear Lift Cylinder Service

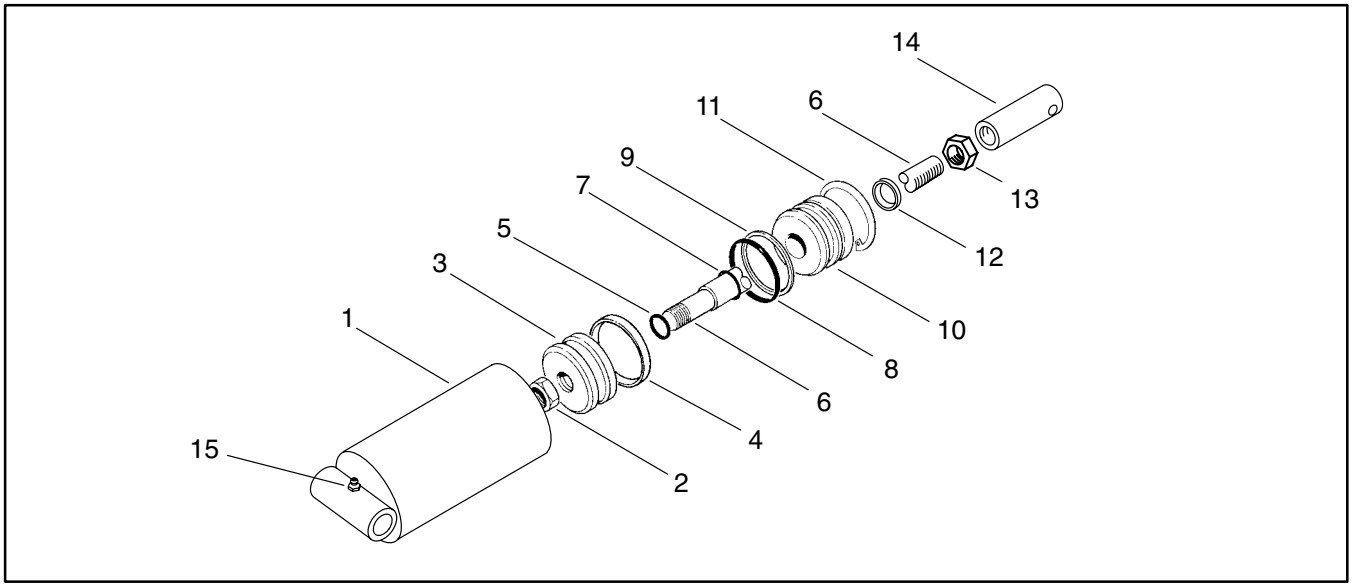

Figure 54

1. **Barrel**
2. **Lock nut**
3. **Piston**
4. **Uni–ring**
5. **O–ring**
6. **Shaft**
7. **O–ring**
8. **O–ring**
9. **Backup washer**
10. **Head**
11. **Retaining ring**
12. **Dust seal**
13. **Jam nut**
14. **Clevis rod**
15. **Grease fitting**

Disassembly (Fig. 54)

1. Remove oil from cylinder into a drain pan by **slowly** pumping the cylinder shaft. Plug both ports and clean the outside of the lift cylinder.

IMPORTANT: Prevent damage when clamping the lift cylinder into a vise; clamp on the pivot end only. Do not close vise enough to distort the barrel.

2. Mount lift cylinder in a vise so that the shaft end tilts up slightly.

3. Remove retaining ring (11) from the barrel.

4. Grasp clevis rod (14); extract shaft (6), head (10), and piston (3) by carefully twisting and pulling the shaft out from the barrel.

IMPORTANT: Do not clamp vise jaws against shaft surface. Protect shaft surface before mounting in the vise.

5. Mount shaft securely in a vise. Remove locknut and piston from the shaft. Slide head off the shaft.

6. Remove and discard uni–ring (4) and O–ring (5) from the piston. Remove and discard dust seal (12), backup washer (9), and O–rings (7 and 8) from the head.

NOTE: If the clevis rod (14) is to be removed from the shaft (6), note the number of threads exposed between the jam nut (13) and the smooth surface of the shaft to help reassembly.

7. Loosen jam nut and remove clevis rod if necessary.

Inspection

CAUTION

Use eye protection such as goggles when using compressed air.

1. Wash all cylinder components in solvent. Dry parts with compressed air.

2. Inspect internal surface of barrel for deep scratches, out–of–roundness, and bending. Replace if worn or damaged.

3. Inspect head, shaft, and piston for excessive pitting, scoring, and wear. Replace any worn or damaged parts.

Reassembly (Fig. 54)

1. Coat new dust seal, uni–ring, backup washer, and all O–rings lightly with hydraulic oil. Install new O–ring and uni–ring to the piston. Install O–rings and backup washer to the head. Press dust seal into head.

IMPORTANT: Do not clamp vise jaws against shaft surface. Protect shaft surface before mounting in vise.

2. Mount shaft securely in a vise. Adjust clevis and jam nut so the number of threads exposed between the jam nut and the smooth surface of the shaft is the same as noted during disassembly. The jam nut must be tight against rod clevis for this adjustment.

3. Coat shaft lightly with hydraulic oil. Slide head onto the shaft being careful not to damage O–ring and dust seal.

4. Install piston onto the shaft being careful not to damage O–ring. Install locknut onto the shaft and tighten.

5. Remove shaft from vise.

IMPORTANT: Prevent damage when clamping the barrel into a vise; clamp on the pivot end only. Do not close vise enough to distort barrel.

6. Mount barrel in a vise so that the shaft end tilts up slightly.

7. Coat all internal lift cylinder parts with a light coat of hydraulic oil. Slide piston, shaft, and head assembly into barrel being careful not to damage the seals.

8. Secure head in barrel by installing retaining ring into barrel groove.

Control and Lift Relief Valves

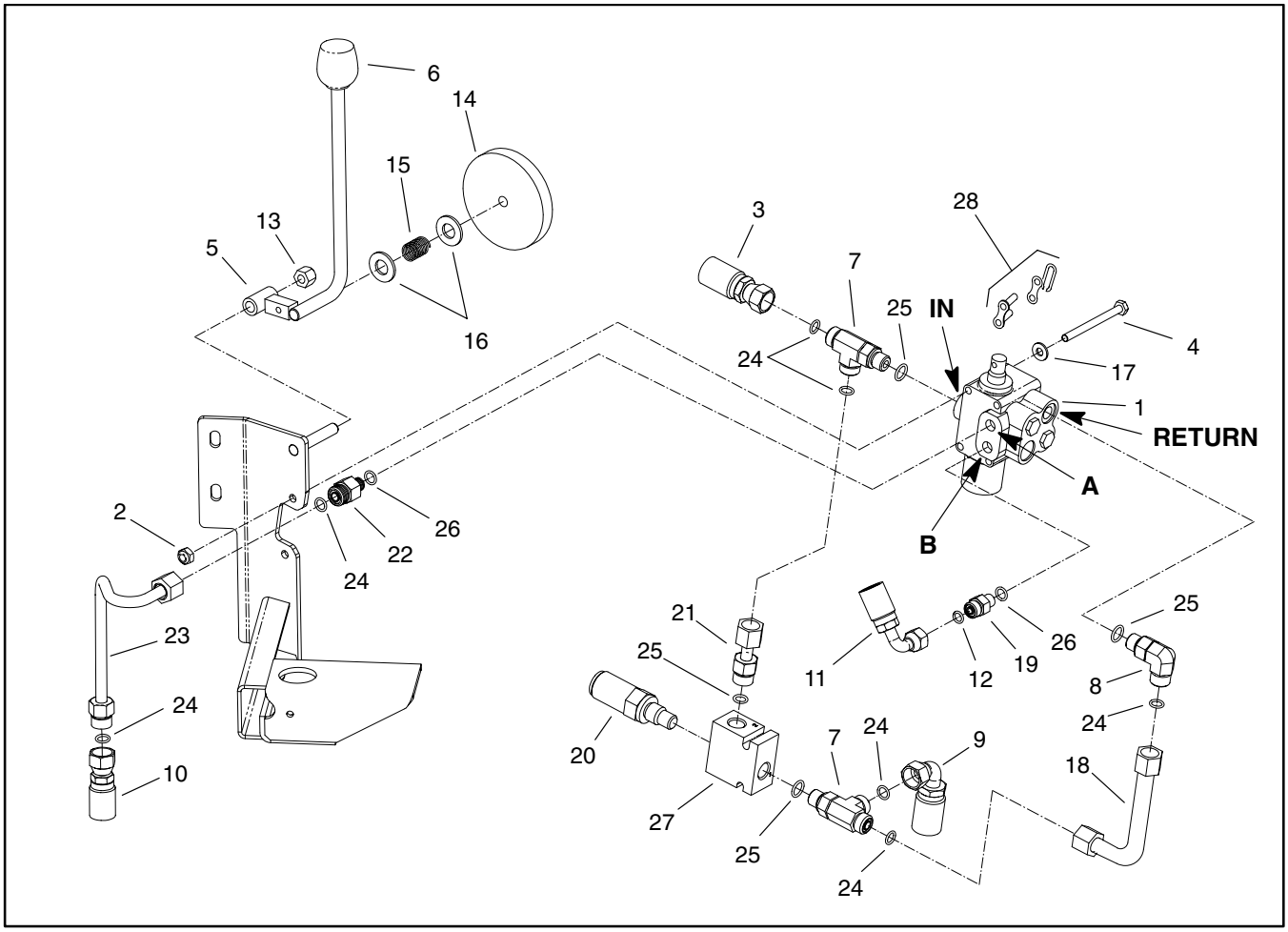

Figure 55

1. **Control valve**
2. **Lock nut**
3. **Hydraulic hose**
4. **Cap screw**
5. **Valve lever**
6. **Knob**
7. **Hydraulic tee fitting**
8. **90º hydraulic fitting**
9. **Hydraulic hose**
10. **Hydraulic hose**
11. **Hydraulic hose**
12. **O–ring**
13. **Lock nut**
14. **Sponge**
15. **Spring**
16. **Flat washer**
17. **Flat washer**
18. **Hydraulic tube**
19. **Straight hydraulic fitting**
20. **Relief valve cartridge**
21. **Hydraulic tube**
22. **Hydraulic adapter**
23. **Hydraulic tube**
24. **O–ring**
25. **O–ring**
26. **O–ring**
27. **Relief valve body**
28. **Connecting link**

1. Park the machine on a level surface, engage the parking brake, lower the cutting units, and stop the engine. Remove the key from the ignition switch.

CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.

2. Remove side panels. Lift hood to gain access to the control valve and relief valve.

Control Valve Removal (Fig. 55)

1. Disconnect hose connections (3, 9, and 11) from hydraulic fittings (7 and 19) and tube connection (23) from fitting (22). Allow hoses to drain into a suitable container.

2. Remove lock nut (13) that secures valve lever to machine.

3. Remove two lock nuts (2). Slide cap screws (4) and washer (17) from the control valve (1).

4. Slide control valve (1) from the support bracket and remove from the unit.

5. Unsnap and remove connecting link assembly (28). Remove valve lever (5) from the control valve (1).

6. Disconnect tube (21) from hydraulic fitting (7). Disconnect tube (18) from 90º hydraulic fitting (8).

7. Remove hydraulic fittings (7, 8, 19, and 22) and O–rings from the control valve (1).

Control Valve Installation (Fig. 55)

1. Install hydraulic fittings (7, 8, 19, and 22) and new o–rings to the control valve (1).

2. Install tube (21) to hydraulic fitting (7). Connect tube (18) to 90º hydraulic fitting (8).

3. Install valve lever (5) to the control valve (1) by snapping the connecting link assembly (28) to the valve lever and control valve.

4. Position control valve (1) to machine and slide valve lever onto support bracket pin.

5. Slide cap screw (4) with flat washer into control valve (1). Secure control valve with lock nuts (2) and valve lever with lock nut (13).

6. Connect hose connections (3, 9, and 11) to hydraulic fittings (7 and 19) and tube connection (23) to fitting (22). Tighten connections.

Lift Relief Valve Removal (Fig. 55)

NOTE: This procedure may be used if only the lift relief valve needs removal from the unit.

1. Disconnect hose connection (9) from hydraulic tee fitting (7). Allow hose to drain hydraulic oil into a suitable container.

2. Disconnect tube (21) from hydraulic tee fitting (7). Allow fitting to drain into a suitable container.

3. Remove lift relief valve body (27) and hydraulic tee fitting (7) from tube (18).

4. Remove hydraulic tee fitting (7), tube (21), and both O–rings from the lift relief valve body (27).

Lift Relief Valve Installation (Fig. 55)

NOTE: This procedure may be used if only the lift relief valve has been removed from the unit.

1. Install hydraulic tee fitting (7) with new O–ring to the lift relief valve body (27).

2. Install tube (21) with new O–ring to the lift relief valve body (27).

3. Set lift relief valve body (27) with attached fitting and tube into the unit.

4. Connect tube (21) to hydraulic tee fitting (7).

5. Connect tube (18) to hydraulic tee fitting (7).

6. Connect hose connection (9) to hydraulic tee fitting (7).

7. Follow Hydraulic System Start–up procedures.

Control Valve Disassembly (Fig. 56)

1. Wash control valve in solvent and dry it thoroughly.

2. Mount control valve into a vise so the mounting pads are against the jaws of the vice and snap ring faces up.

NOTE: Remove check valve seat only if it needs replacement; it is pressed into the valve body.

3. Remove plugs and O–rings from the valve body. Remove springs, balls, and cam pins from the valve body.

4. Remove snap ring from the bottom of the valve body. Remove spool snap ring, spring retainer, spacer, and spring.

5. Push and twist spool carefully out of the valve body. Set spool aside.

6. Remove O–rings from valve body using a soft hooked scribe or a thin screwdriver taking care not to scratch the valve bore finish.

Control Valve Inspection (Fig. 56)

CAUTION

Use eye protection such as goggles when using compressed air

1. Wash all parts in solvent. Dry parts with compressed air.

2. Inspect spool for bending and flatness. Signs of wear on one side of the spool may indicate damage. Replace a worn or damaged spool if necessary.

3. Inspect other components for wear or damage, and replace damaged items as necessary.

Control Valve Reassembly (Fig. 56)

1. Coat all new O–rings with hydraulic oil. Install new O–rings into the bore of the valve body.

2. Coat spool lightly with hydraulic oil. Push and twist spool carefully into the valve body. Avoid damaging O–rings.

3. Install spring retainer, spring, spacer, second spring retainer, and spool snap ring onto the spool. Install snap ring into the valve body.

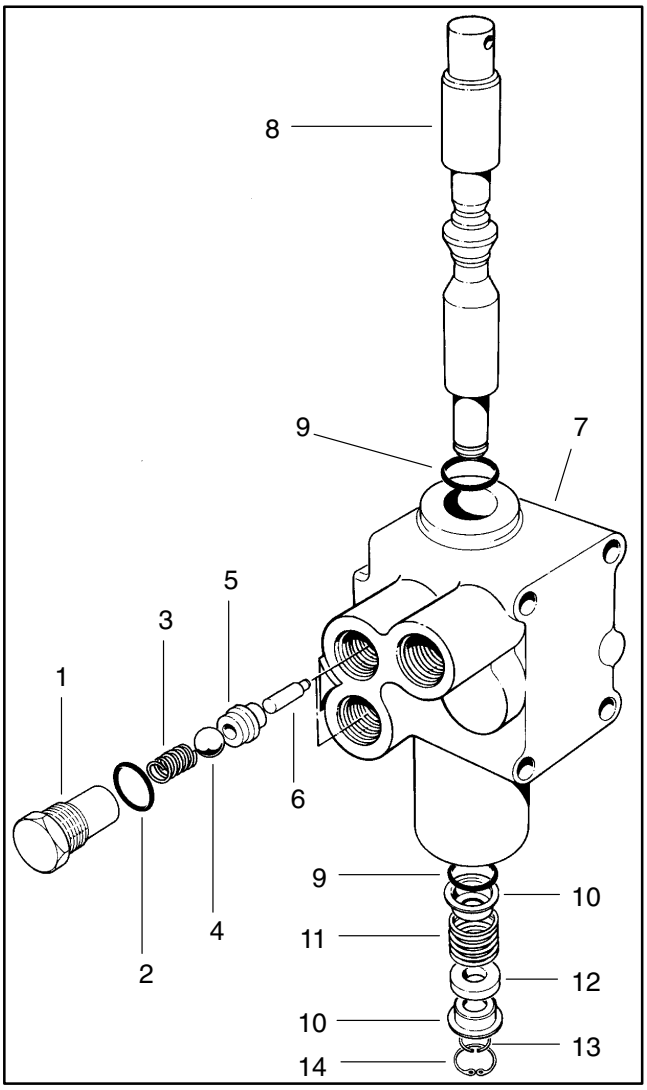

Figure 56

1. **Plug**
2. **O–ring**
3. **Spring**
4. **Ball**
5. **Check valve seat**
6. **Cam pin**
7. **Control valve body**
8. **Spool**
9. **O–ring**
10. **Spring retainer**
11. **Spring**
12. **Spacer**
13. **Spool snap ring**
14. **Snap ring**

4. If check valve seat was damaged and removed, press fit replacement into the valve body.

5. Lubricate and install cam pin, ball, and spring. Place new O–ring on plug and install them into the valve body. Tighten plug.

6. Repeat steps 4 and 5 for the second plug assembly.

Hydraulic Reservoir

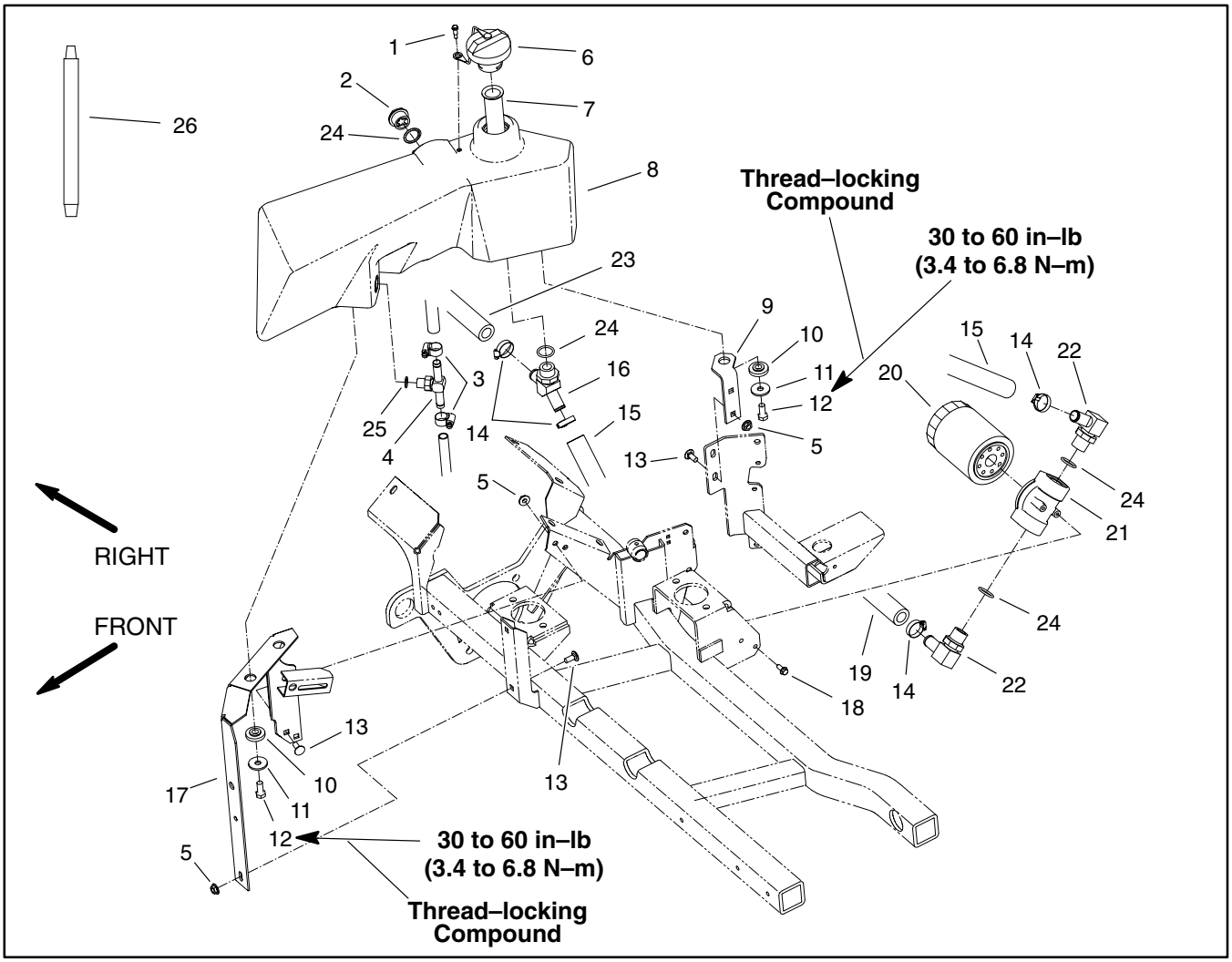

Figure 57

1. **Shoulder screw**
2. **Sight glass**
3. **Hose clamp**
4. **Tee fitting**
5. **Nut**
6. **Hydraulic reservoir cap**
7. **Screen filter**
8. **Hydraulic tank**
9. **Tank bracket**
10. **Tank mount grommet**
11. **Washer**
12. **Cap screw**
13. **Carriage screw**
14. **Hose clamp**
15. **Hydraulic hose (tank to filter)**
16. **45º hydraulic fitting**
17. **U–bracket**
18. **Flange head screw**
19. **Suction hose**
20. **Oil filter**
21. **Filter head**
22. **90º hydraulic fitting**
23. **Suction hose**
24. **O–ring**
25. **O–ring**
26. **Reservoir plug**

Inspecting Reservoir Parts (Fig. 57)

1. Clean tank and filler screen with solvent.

2. Inspect tank for leaks, cracks, or other damage.

3. Replace hydraulic hoses if worn or leaking.

4. Make sure all three tank mounting cap screws are secure. If loose, remove cap screw, apply medium strength thread–locking compound to threads, and reinstall. Torque cap screws from 30 to 60 in–lb (3.4 to 6.8 N–m).

5. Make sure all bracket fasteners are tight.

Oil Cooler

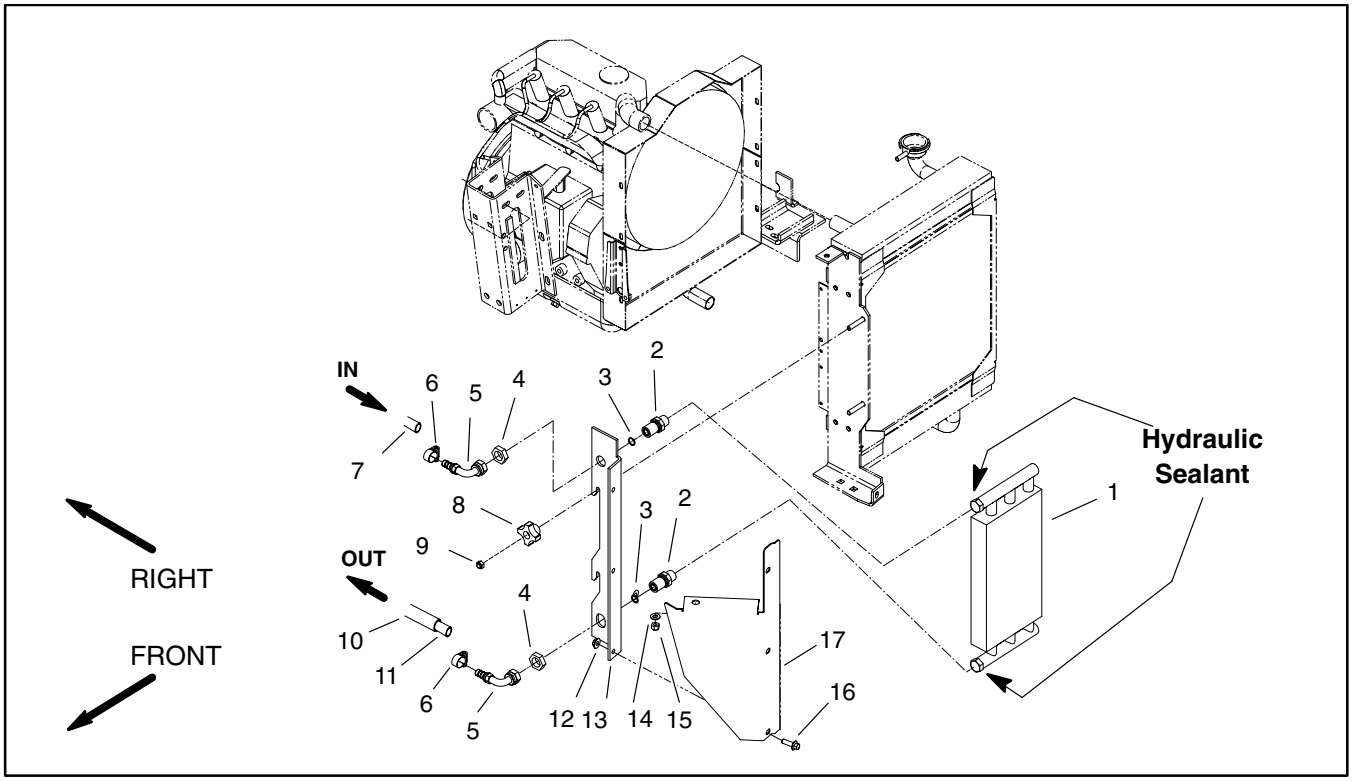

Figure 58

1. **Oil cooler**
2. **Hydraulic connector**
3. **O–ring**
4. **Bulkhead nut**
5. **90º hydraulic fitting**
6. **Hose clamp**
7. **Hydraulic hose (from manifold)**
8. **Knob**
9. **Lock nut**
10. **Protective sleeve**
11. **Hydraulic hose (to reservoir)**
12. **Nut**
13. **Front screen bracket**
14. **Flat washer**
15. **Lock nut**
16. **Flange head screw**
17. **Left front panel**

Removal (Fig. 58)

1. Park machine on a level surface, lower cutting units, stop engine, engage parking brake, and remove key from the ignition switch.

2. Open and remove the hood (see Traction Unit Operator's Manual). Remove the radiator screen.

3. Loosen hose clamps and remove both hydraulic hoses from fittings on oil cooler. Allow hoses to drain oil into a suitable container.

4. Remove 90º hydraulic fittings from oil cooler assembly. Remove and discard o–rings from connectors.

5. Remove bulkhead nuts from oil cooler assembly.

6. Pull oil cooler from screen bracket.

7. If necessary, remove hydraulic connectors from oil cooler.

Installation (Fig. 58)

1. If hydraulic connectors were removed, apply hydraulic sealant to threads of connectors. Install connectors to oil cooler. Coat new o–rings with hydraulic oil. Install new o–rings in connectors.

2. Position and secure oil cooler to screen bracket with bulkhead nuts.

3. Install 90º hydraulic fittings to oil cooler assembly. Orientate top fitting straight back and bottom fitting 45º down.

4. Install hydraulic hoses to fittings and secure with hose clamps.

5. Install hood on the machine.

Chapter 5

Electrical System

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Electrical Schematics and Electrical Harness and Connectors Drawings

The electrical schematics and other electrical drawings for the Reelmaster 2000–D are located in Chapter 8 – Electrical Diagrams.

Special Tools

Order these special tools from your Toro Distributor. Some tools may also be available from a local supplier.

Multimeter

The multimeter can test electrical components and circuits for current, resistance, or voltage.

NOTE: Toro recommends the use of a DIGITAL Volt-Ohm-Amp multimeter when testing electrical circuits. The high impedance (internal resistance) of a digital meter in the voltage mode will make sure that excess current is not allowed through the meter. This excess current can cause damage to circuits not designed to carry it.

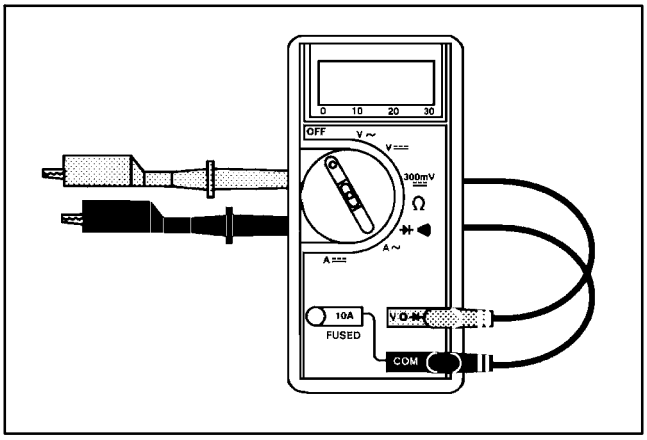

Figure 1

Skin-Over Grease

Special non-conductive grease (Toro Part Number 505-165) which forms a light protective skin to help waterproof electrical switches and contacts.

Figure 2

Troubleshooting

CAUTION

Remove all jewelry, especially rings and watches, before doing any electrical trouble-shooting or testing. Disconnect the battery cables unless the test requires battery voltage.

For effective troubleshooting and repairs, you must have a good understanding of the electrical circuits and components used on this machine (see Chapter 8 – Electrical Diagrams).

If the machine has any interlock switches by–passed, they must be reconnected for proper troubleshooting and safety.

Starting Problems

Problem	Possible Causes
Starter solenoid clicks, but starter will not crank (if solenoid clicks, problem is not in safety interlock system).	Battery charge is low. Battery cables are loose or corroded. Battery ground to frame is loose or corroded. Wiring at starter is faulty. Starter solenoid is faulty. Starter mounting bolts are loose or not supplying a sufficient ground for solenoid. Starter is faulty.
Nothing happens when start attempt is made (either seat switch OR parking brake must be engaged for successful start).	Reel engage switch is **ON** (pulled out) or is faulty. Battery cables are loose or corroded. Battery ground to frame is loose or corroded. Battery is dead. Engine fuse (15 amp) is open. Fusible link is open. Wiring to start circuit components is loose, corroded, or damaged (see Wiring Schematics). Traction neutral switch out of adjustment or faulty. Ignition switch is faulty. Fuse block is faulty. High temperature shutdown switch is faulty. Starter solenoid is faulty. Standard Control Module is faulty.

Starting Problems (continued)

Problem	Possible Causes
Engine cranks, but does not start.	Engine run solenoid is faulty. Glow plugs are faulty. Engine or fuel system is malfunctioning (see Chapter 3 – Engine). Engine and/or fuel may be too cold. Standard Control Module is faulty.
Engine cranks (but should not) with the traction pedal out of the neutral position.	Traction neutral switch is out of adjustment or faulty. Traction neutral switch wiring is faulty.

General Run and Transport Problems

Problem	Possible Causes
Engine continues to run (but should not) when the traction pedal is depressed with no operator on the seat.	Seat switch is faulty, out of adjustment, or short circuited. Traction neutral switch is out of adjustment, faulty, or short circuited.
Engine kills when the traction pedal is depressed or the reel engage switch is pulled **ON** with the operator in the seat.	Operator is lifting off the seat (seat switch not depressed). Parking brake is on. Seat switch is faulty or out of adjustment. Seat switch wiring is loose, corroded, or damaged.
Battery does not charge.	Wiring to the charging circuit components is loose, corroded, or damaged (see Wiring Schematics). Fusible link to the battery is faulty. Alternator is faulty. Battery is dead.
Engine kills during operation (operator sitting on seat).	Operator is lifting off the seat (seat switch not depressed). Seat switch is faulty or out of adjustment. Seat switch wiring is loose, corroded, or damaged. Engine overheated. Ignition switch is faulty. Wiring to the run circuit components are damaged or disconnected (see Wiring Schematics). Standard Control Module is faulty.

Cutting Unit Operating Problems

Problem	Possible Causes
Engine Continues to run (but should not) when the reel engage switch is **ON** with no operator in the seat.	Backlap switch is in the backlap position. Backlap switch is faulty or out of adjustment. Wiring to the mow/backlap circuit components is loose, corroded, or damaged (see Wiring Schematics). Seat switch is faulty, out of adjustment, or short circuited.
Cutting units run (but should not) when raised. However, they shut off with the reel engage switch.	Cutting deck position switch or circuit wiring is faulty or out of adjustment.
Cutting units shut off when raised. However, they do not shut off with the reel engage switch.	Reel engage switch is faulty or short circuited.
Cutting units do not engage.	Operator not present in seat. Cutting units are not lowered. System fuse (10 amp) is open. Fuse block is faulty. Seat switch is faulty or out of adjustment. Wiring to mow/backlap circuit components is loose, corroded, or damaged (see Wiring Schematics). Reel engage switch is faulty. Cutting unit interlock switch is faulty. Cutting unit solenoid valve or coil on hydraulic manifold is faulty.
Cutting units do not engage in Backlap direction.	Cutting units are not lowered. Parking Brake is not engaged. System fuse (10 amp) is open. Fuse block is faulty. Seat switch is faulty or out of adjustment. Parking brake switch is faulty or out of adjustment. Wiring to mow/backlap circuit components is loose, corroded, or damaged (see Wiring Schematics). Reel engage switch is faulty. Backlap switch is faulty or out of adjustment. Cutting unit interlock switch is faulty. Cutting unit solenoid valve or coil on hydraulic manifold is faulty.

Electrical System Quick Checks

Battery Test (Open Circuit Test)

Use a multimeter to measure the voltage between the battery terminals.

Set the multimeter to the DC volts setting. The battery should be at a temperature of 60º to 100º F (16º to 38º C). The ignition key should be in the OFF position and all accessories turned off. Connect the positive (+) meter lead to the positive battery post and the negative (–) meter lead to the negative battery post.

NOTE: This test provides a relative condition of the battery. Load testing of the battery will provide additional and more accurate information.

Voltage Measured	Battery Charge Level
12.68 v (or higher)	Fully charged (100%)
12.45 v	75% charged
12.24 v	50% charged
12.06 v	25% charged
11.89 v	0% charged

Charging System Test

This is a simple test used to determine if a charging system is functioning. It will tell you if a charging system has an output, but not its capacity.

Tool required: Digital multimeter set to DC volts.

Test instructions: Connect the positive (+) meter lead to the positive battery post and the negative (–) meter lead to the negative battery post. Leave the test leads connected and record the battery voltage.

NOTE: Upon starting the engine, the battery voltage will drop and then should increase once the engine is running.

NOTE: Depending upon the condition of the battery charge and battery temperature, the charging system voltage will increase at different rates as the battery charges.

Start the engine and run at 3200 RPM. Allow the battery to charge for at least 3 minutes. Record the battery voltage.

Test results should be (example):

At least 0.50 volt over initial battery voltage.	
Initial Battery Voltage	= 12.30 v
Battery Voltage after 3 Minute Charge	= 12.80 v
Difference	= +0.50 v

Glow Plug System Test

This is a fast, simple test that can help to determine the integrity and operation of the glow plug system. The test should be run anytime hard starting (cold) is encountered on a diesel engine equipped with a glow plug system.

Tool(s) required: Digital multimeter and/or inductive Ammeter (AC/DC Current Transducer).

Test instructions: Properly connect the ammeter to the digital multimeter (refer to manufacturer's instructions).

Set the multimeter to the correct scale. With the key in the OFF position, place the ammeter pickup around the main glow plug power supply wire and read the meter prior to activating glow plug system. Adjust the meter to read zero (if applicable). Cycle the glow plug system at least two times (per instructions in Traction Unit Operator's Manual) and record the final results.

The Reelmaster 2000–D glow plug system should have a reading of about 27 Amps.

Starting System Test

This is an excellent test to use when a “slow crank/no start” problem is encountered. It will determine if the problem is due to an electrical open, short, or high resistance in the starter circuit.

NOTE: The battery condition and state of charge must be checked before testing the starter system.

Tool(s) required: Digital multimeter and/or inductive Ammeter (AC/DC Current Transducer).

Test instructions: Properly connect the ammeter to the digital multimeter (refer to manufacturers instructions). Set the multimeter to the correct scale. With the key in the OFF position, place the ammeter pickup around the main negative (–) battery cable and read the meter prior to activating the starter system. Adjust the meter to read zero (if applicable). Crank the engine for at least 3 seconds and record the results. Maximum starter system draw for the RM 2000–D is 140 Amps at 65º F (18º C).

If current draw is significantly higher than listed, check for a shorted condition. If current draw is significantly lower than listed, check for high resistance.

Check Operation of Interlock Switches

CAUTION

Do not disconnect safety switches. They are for the operator’s protection. Check the operation of the interlock switches daily for proper operation. Replace any malfunctioning switches before operating the machine.

Interlock switch operation is described in the Traction Unit Operator’s Manual. The Reelmaster 2000–D is equipped with a Standard Control Module which monitors interlock switch operation. Information on this Module is described in the Component Testing of this Chapter and in the Traction Unit Operator’s Manual. Testing of individual interlock switches is included in the Component Testing section of this Chapter.

Adjustments

Neutral Switch

1. Adjust the neutral switch so that the switch opens when the traction pedal is moved forward 1 inch (2.5 cm), measured at the top of pedal.

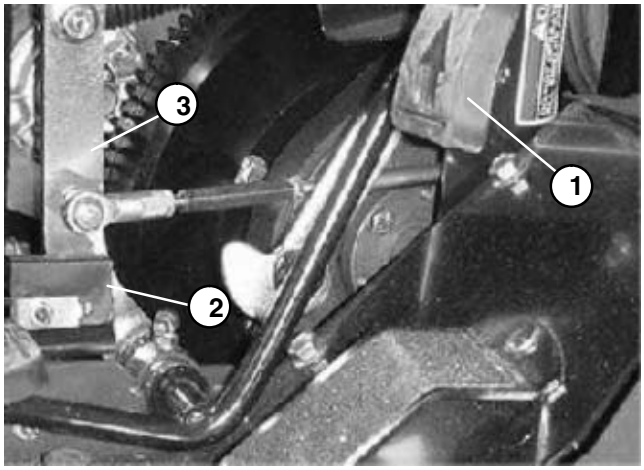

Figure 3

1. Traction pedal
2. Neutral switch
3. Traction arm

Parking Brake Switch

1. Adjust parking brake switch so switch opens within two (2) clicks of parking brake lever movement.

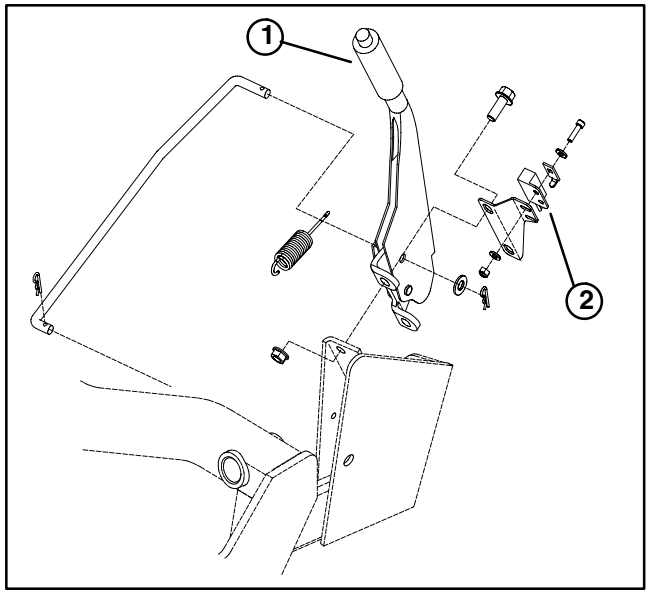

Figure 4

1. Parking brake lever
2. Brake switch

Component Testing

For accurate resistance and/or continuity checks, electrically disconnect the component being tested from the circuit (e.g. unplug the ignition switch connector before doing a continuity check).

NOTE: Electrical troubleshooting of any 12 Volt power connection can be performed through voltage drop tests without disconnecting the component.

NOTE: See the Briggs & Stratton/Daihatsu Engine Repair Manual for more component testing information.

CAUTION

When testing electrical components for continuity with a multimeter (ohms setting), make sure that power to the circuit has been disconnected.

Ignition Switch

The ignition (key) switch has three positions (OFF, ON, and START). The terminals are marked as shown. The circuit wiring of the ignition switch is shown in the chart. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals.

POSITION	CIRCUIT
OFF	NONE
ON	B + I + A, X + Y
START	B + I + S

The Standard Control Module monitors the operation of the ignition switch. If the ignition switch is in the ON position, the Module power input LED should be illuminated. If the ignition switch is in the START position, the Module start output LED should also be illuminated.

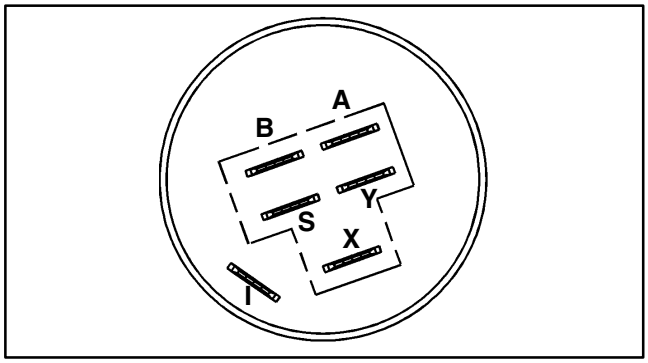

Figure 5

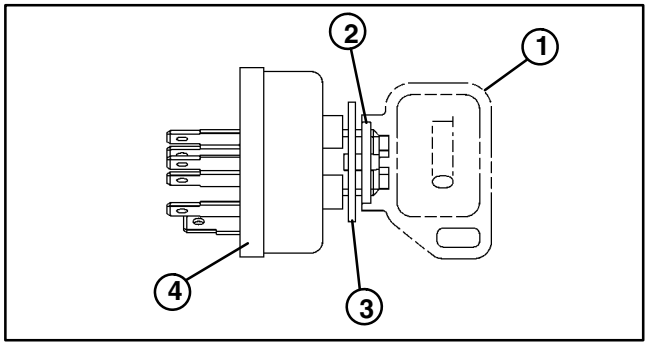

Figure 6

1. Key
2. Hex nut
3. Lock washer
4. Ignition switch

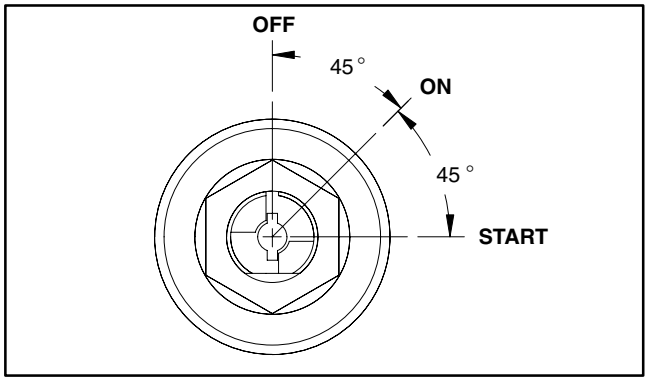

Figure 7

Indicator Lights

Engine Oil Pressure Light

The oil pressure light should come on when the ignition switch is in the ON position with the engine not running. Also, it should light with the engine running if the engine oil pressure drops below 4.3 PSI (0.3 kg/cm^2).

To test the oil pressure light and circuit wiring, ground the gray wire attached to oil pressure switch located on the front side of engine near the oil dipstick. Turn ignition switch to the ON position; the oil pressure light should come on indicating correct operation of the electrical wiring to the oil pressure switch.

High Temperature Shutdown Light

If the engine coolant temperature rises to 238^{o}F (114^{o}C), the high temperature light should come on as the high temperature shutdown switch stops the engine.

To test the high temperature shutdown light and circuit wiring, start the engine and ground the blue/white wire attached to high temperature shutdown switch located on water pump housing (see High Temperature Shutdown Switch in this Chapter). Warning light should illuminate and engine should stop running.

Glow Plug Indicator Light

The glow plug light should come on when the ignition switch is placed in the ON position prior to placing the ignition switch in START. The light should stay lit for approximately 5 seconds while the ignition switch is left in the ON position.

Charge Indicator Light

The charge indicator light should come on when the ignition switch is in the ON position with the engine not running, or with an improperly operating charging circuit while the engine is running.

Testing Indicator Lights

1. Apply 12 VDC to terminals 1A and 2A (Fig. 9).

2. Ground terminals 1B and 2B (Fig. 9).

3. Both indicator lights should illuminate.

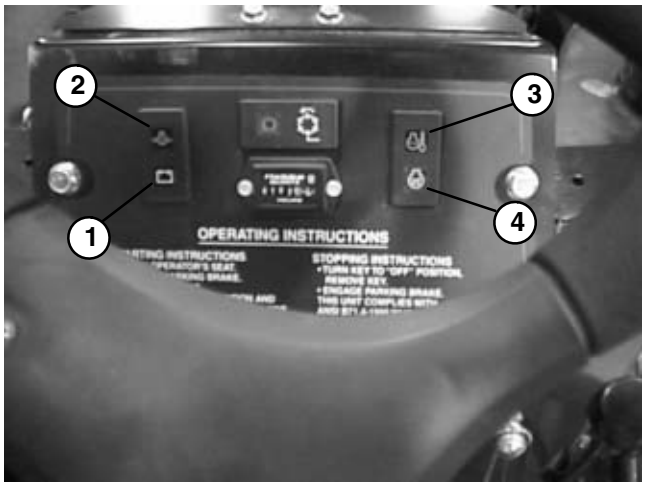

Figure 8

1. Charge indicator
2. Engine oil pressure
3. High temp shutdown
4. Glow plug indicator

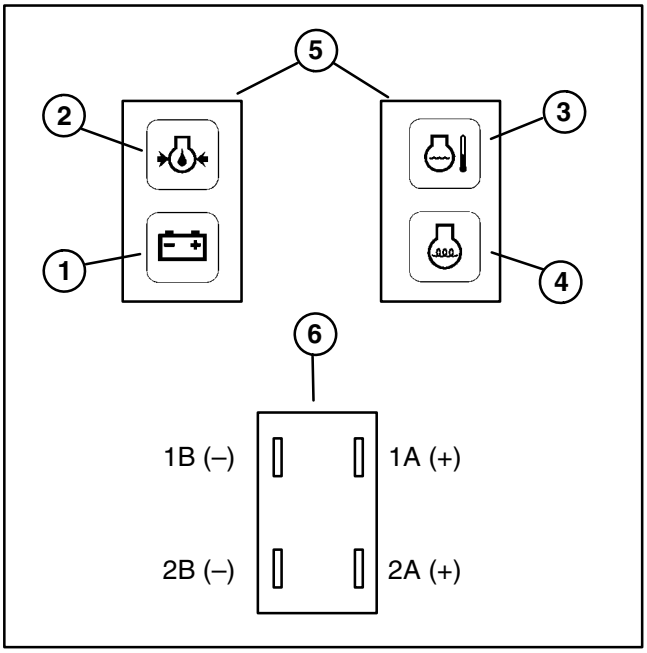

Figure 9

1. Charge indicator
2. Engine oil pressure
3. High temp shutdown
4. Glow plug indicator
5. Warning light front
6. Warning light back

Hour Meter

1. Connect the positive (+) terminal of a 12 VDC source to the positive (+) terminal of the hour meter.

2. Connect the negative (–) terminal of the voltage source to the other terminal of the hour meter.

3. The hour meter should move a 1/10 of an hour in six minutes.

4. Disconnect the voltage source from the hour meter.

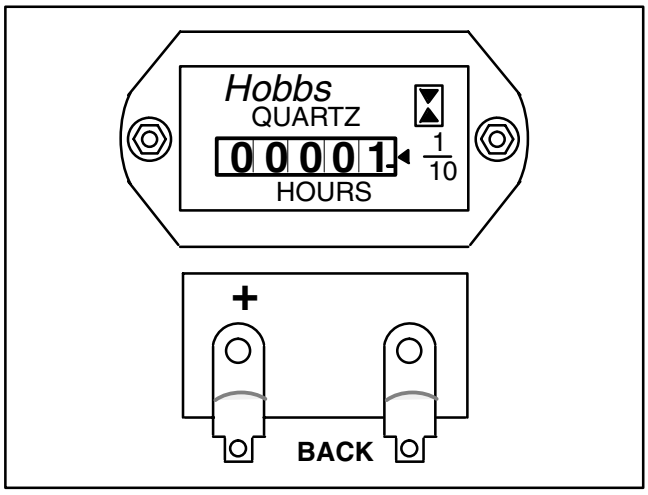

Figure 10

Reels On Indicator Light

The reels on indicator light should illuminate when the reels are engaged.

Testing Indicator Light

1. Apply 12 VDC to terminal 1A (Fig. 9).

2. Ground terminals 1B (Fig. 9).

3. Indicator light should illuminate.

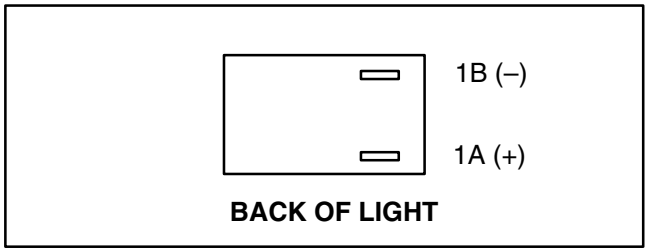

Figure 11

Reel Engage Switch

The reel engage switch is mounted on the instrument panel and is pulled to engage the cutting reels. The Reelmaster 2000–D uses only two of the six switch terminals. When the switch knob is pulled, switch terminals 1 (COM C) and 4 should have continuity (Fig. 12). When the switch knob is pushed in, switch terminals 1 (COM C) and 4 should not have continuity.

The Standard Control Module monitors the operation of the reel engage switch. If the ignition switch is in the ON position and the reel engage switch is pulled, the Module PTO switch input LED should be illuminated.

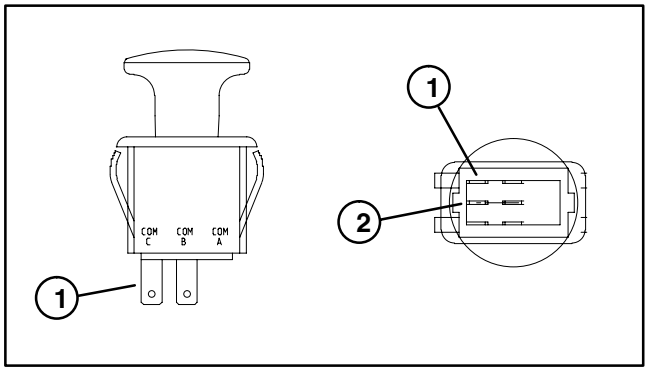

Figure 12

1. Terminal 1 (COM C) **2. Terminal 4**

Glow Relay

The glow relay is attached to the instrument panel. When energized, the glow relay allows electrical current to the glow plugs.

NOTE: Prior to taking small resistance readings with a digital multi meter, short the meter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from from the measured value of the component you are testing.

NOTE: The glow relay may be manufactured by one of two different manufacturers. Verify manufacturer name and part number before performing the resistance check on the relay coil.

1. Verify coil resistance between terminals 85 and 86 with a multimeter (ohms setting):

   A. For the Tyco Electronics relay (#VF7–41F11–S01), resistance should be approximately 72 ohms.

   B. For the Hella Electronics relay (#87430B), resistance should be approximately 100 ohms.

2. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87 as +12 VDC is applied and removed from terminal 85.

3. Disconnect voltage and leads from the relay terminals.

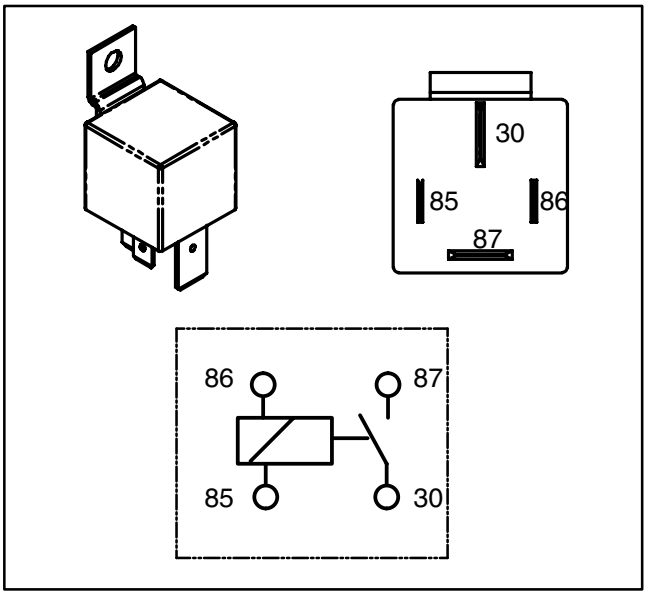

Figure 13

High Temperature Shutdown Switch

The high temperature shutdown switch is located on the top of the water pump housing. The water pump is on the left end of the engine inside the fan pulley assembly. There is a blue/white wire attached to the shutdown switch.

The Standard Control Module monitors the operation of the high temperature shutdown switch. If the ignition switch is in the ON position and the high temperature shutdown switch is closed (excessive coolant temperature), the Module Hi Temp input LED should be illuminated.

High Temperature Shutdown Switch Test

1. Lower the coolant level in the engine and remove the high temperature shutdown switch.

2. Put the switch in a container of oil with a thermometer and slowly heat the oil (Fig. 15).

CAUTION

Handle the hot oil with extreme care to prevent personal injury or fire.

3. Check the continuity of the switch with a multimeter (ohms setting). The switch is normally open and should close at 238°F (114°C).

4. Allow the oil to cool. The switch should open at 232°F (111°C).

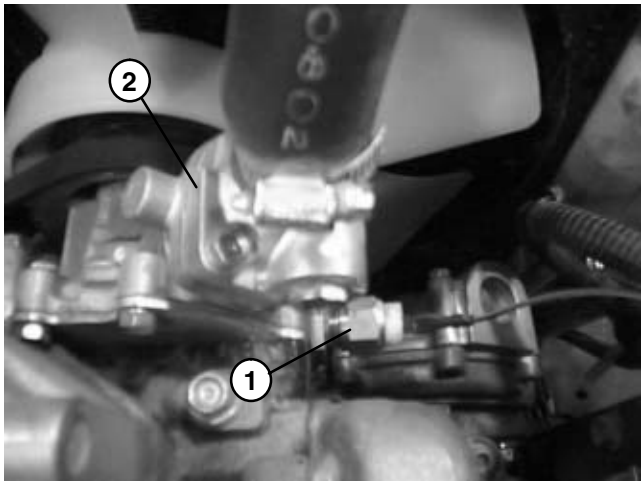

Figure 14

1. Temperature switch
2. Water pump housing

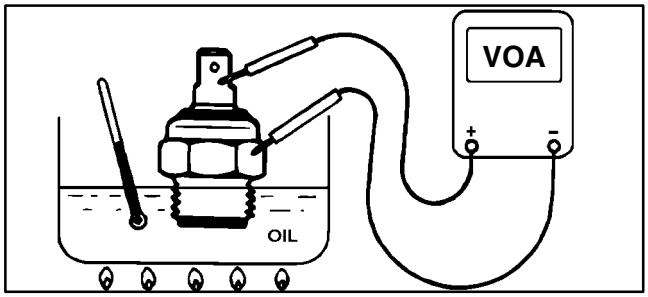

Figure 15

Oil Pressure Switch

The engine oil pressure switch is located on the cylinder near the dipstick and oil filter. It is a normally closed switch and opens with pressure. The operating range for the switch is 2.9 to 5.7 PSI (0.2 to 0.4 kg/cm^2).

Testing with the engine off

1. Turn the ignition switch to the ON position. The oil pressure lamp should be on.

2. If the lamp is not on, disconnect the gray wire from the switch and ground the wire to the engine block.

3. If the lamp comes on, the oil pressure switch is bad.

4. If the lamp does not come on after step 2, check the circuit wiring and indicator light.

Testing with the engine running

1. If the lamp is on with the engine running, shut off the engine **immediately**.

2. Disconnect the gray wire from the switch.

3. Turn the ignition switch to ON. The oil pressure lamp should not be illuminated.

4. If the light is still on, check the oil switch circuit wiring.

5. Return ignition switch to OFF and connect the gray wire to the switch.

See the Briggs & Stratton/Daihatsu Engine Repair Manual for engine oil pressure testing procedures.

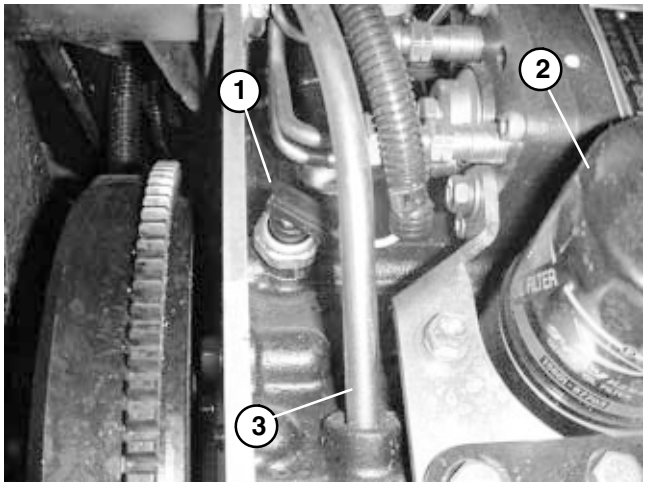

Figure 16

1. **Oil pressure switch**
2. **Oil filter**
3. **Dipstick**

Engine Run Solenoid

The engine run solenoid must be energized for the engine to run. The solenoid is an integral component of the injector pump and has a red/black wire attached to it.

The Standard Control Module monitors the operation of the engine run solenoid. If the ignition switch is either in the ON or START position and the correct switch inputs (seat, parking brake, etc.) are received, the Module engine run output LED should be illuminated.

See the Briggs & Stratton/Daihatsu Engine Repair Manual for engine run solenoid testing procedures.

Solenoid Valve Coil

The hydraulic system on the Reelmaster 2000–D uses a solenoid valve coil on the reel drive manifold and, when equipped with the optional 3WD kit, a second solenoid coil on the 3WD manifold.

NOTE: Prior to taking small resistance readings with a digital multimeter, short the test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from from the measured value of the component you are testing.

NOTE: The solenoid does not have to be removed from the valve for testing.

1. Make sure engine is off. Unplug solenoid valve electrical connector.

2. Apply 12VDC source directly to the solenoid. Listen for solenoid to switch on.

3. Remove 12VDC source from the solenoid. Listen for solenoid to switch off.

4. Measure resistance between the two coil connector terminals.

   A. Resistance of the reel drive solenoid should be about 7.2 ohms.

   B. Resistance of the 3 wheel drive solenoid (if equipped) should be about 7.5 ohms.

5. Reconnect electrical connector to the solenoid.

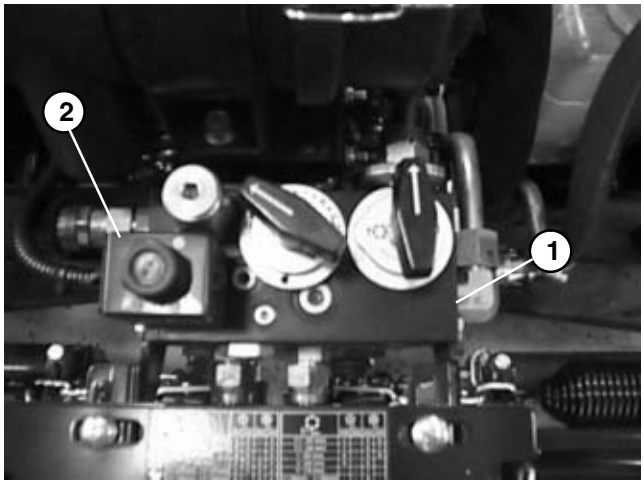

Figure 17

1. **Reel drive hydraulic manifold**
2. **Solenoid valve coil**

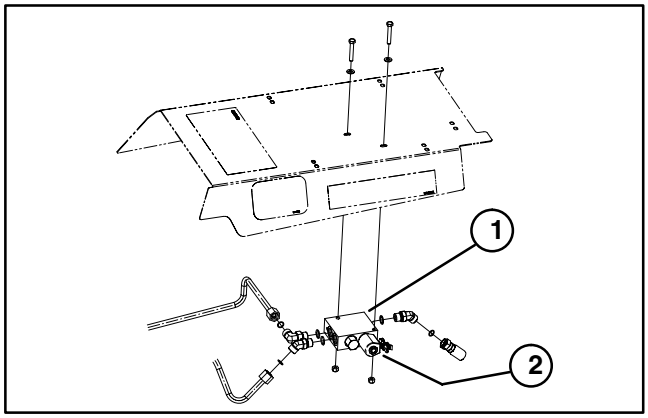

Figure 18

1. **3WD hydraulic manifold**
2. **Solenoid valve coil**

Standard Control Module

The Reelmaster 2000–D is equipped with a Standard Control Module to monitor and control electrical components required for safe operation. This Module is attached to the back of the instrument panel (Fig. 19).

Inputs from the neutral, parking brake, PTO, start (ignition), backlap, and high temperature switches are monitored by the Module. Output to the PTO (reel drive solenoid), electric starter motor, and engine run solenoid are controlled based on the inputs received by the Module.

The Standard Control Module does not connect to an external computer or hand held device, can not be re–programmed, and does not record intermittent fault data.

The Standard Control Module can be used to check operation of machine switches by monitoring the LED of the module. If a Module LED does not illuminate (e.g. the in seat input LED does not illuminate with the seat occupied and the ignition switch in the run position), testing of the switch and circuit wiring would be required.

Refer to the Traction Unit Operator's Manual for operation and troubleshooting of the Standard Control Module.

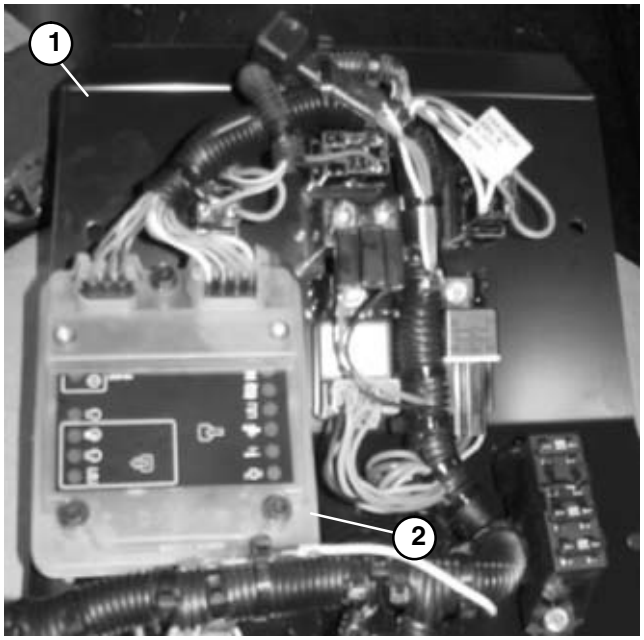

Figure 19

1. **Instrument panel**
2. **Standard control module**

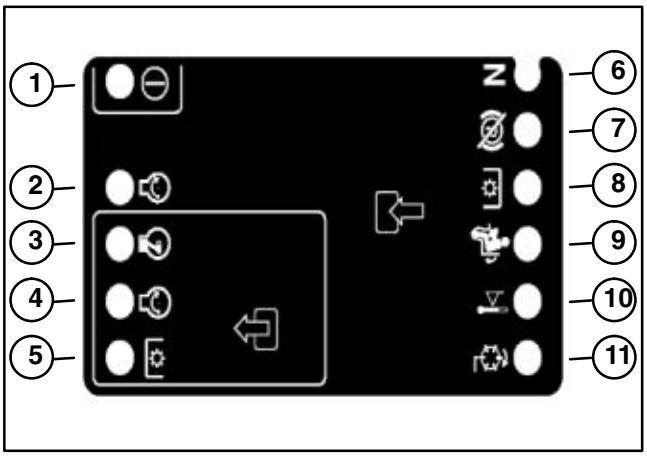

Figure 20

1. **Power input LED**
2. **Start input LED**
3. **Engine run output LED**
4. **Start output LED**
5. **PTO output LED**
6. **Neutral input LED**
7. **Park brake off input LED**
8. **PTO switch input LED**
9. **In seat input LED**
10. **High temp input LED**
11. **Backlap input LED**

Traction Neutral Switch

The traction neutral switch is a normally open proximity switch that closes when the traction pedal is in the neutral position. The traction arm that is pinned to the traction lever acts as the sensing plate for the switch.

The Standard Control Module monitors the operation of the traction neutral switch. If the ignition switch is in the ON position and the traction pedal is in the neutral position, the Module neutral input LED should be illuminated.

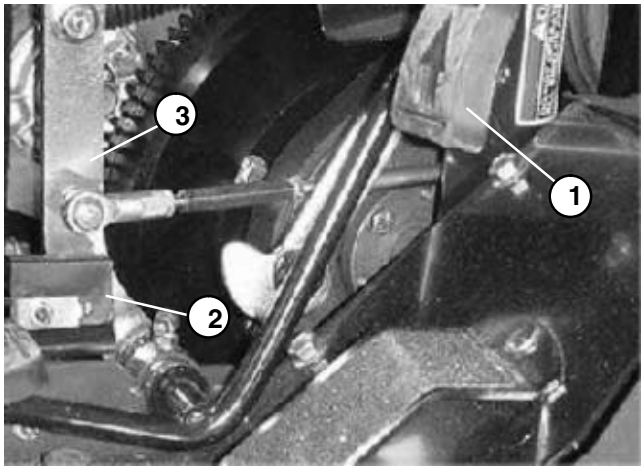

Figure 21

1. **Traction pedal**
2. **Neutral switch**
3. **Traction arm**

Traction Neutral Switch Test

1. Park machine on a level surface, lower cutting units, stop engine, engage parking brake, and remove key from the ignition switch.

2. Disconnect the electrical connector to the neutral switch.

3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.

4. With the ignition switch in the OFF position, slowly push the traction pedal in the forward and reverse direction while watching the multimeter. Continuity should be broken in both the forward and reverse directions.

5. Allow the traction pedal to return to the neutral position. There should be continuity across the terminals.

6. Reconnect the electrical connector to the switch.

Seat Switch

The seat switch is normally open and closes when the operator is on the seat. If either the neutral switch or parking brake switch is open when the operator raises out of the seat, the engine will stop.

The standard seat uses a switch that is fastened to the underside of the seat (Fig. 22). The deluxe seat has a switch that is mounted to the seat base under the cushion. The switch electrical connector for either seat type is located directly under the seat. Testing is the same for either switch type.

The Standard Control Module monitors the operation of the seat switch. If the ignition switch is in the ON position and the seat is occupied, the Module in seat input LED should be illuminated.

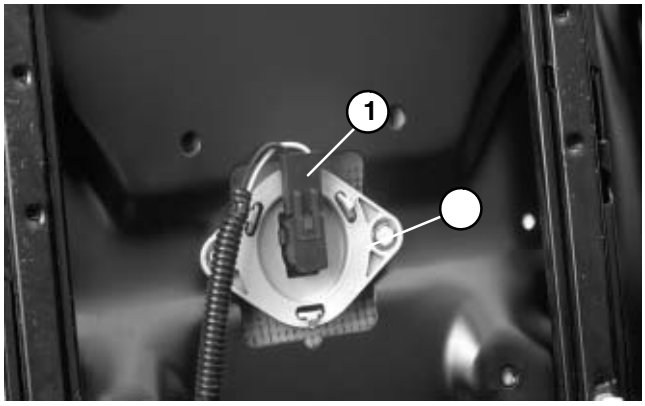

Figure 22

1. **Electrical connector**
2. **Standard seat switch**

Seat Switch Test

1. Make sure the engine is off.

2. Disconnect electrical connector from the seat switch.

3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.

4. With no pressure on the seat, there should be no continuity between the seat switch terminals.

5. Press directly onto the seat switch through the seat cushion. There should be continuity as the seat cushion approaches the bottom of its travel.

6. Reconnect switch connector.

Parking Brake Switch

The parking brake switch is a normally open proximity switch that is mounted on a bracket at the base of the parking brake lever (Fig. 23). The parking brake lever is used as the sensing plate.

When the parking brake is engaged, the brake lever is moved away from the brake switch and the switch opens. This open switch prevents the cutting units from operating.

The Standard Control Module monitors the operation of the parking brake switch. If the ignition switch is in the ON position and the parking brake is not applied, the Module brake off input LED should be illuminated.

Parking Brake Switch Test

1. Park machine on a level surface, lower cutting units, stop engine, engage parking brake, and remove key from the ignition switch.

2. Disconnect parking brake switch from machine wiring harness.

3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the switch connector terminals.

4. With the parking brake disengaged, there should be continuity across the switch terminals.

5. Apply the parking brake. There should be no continuity across the switch terminals.

6. Replace switch as needed. Reconnect switch.

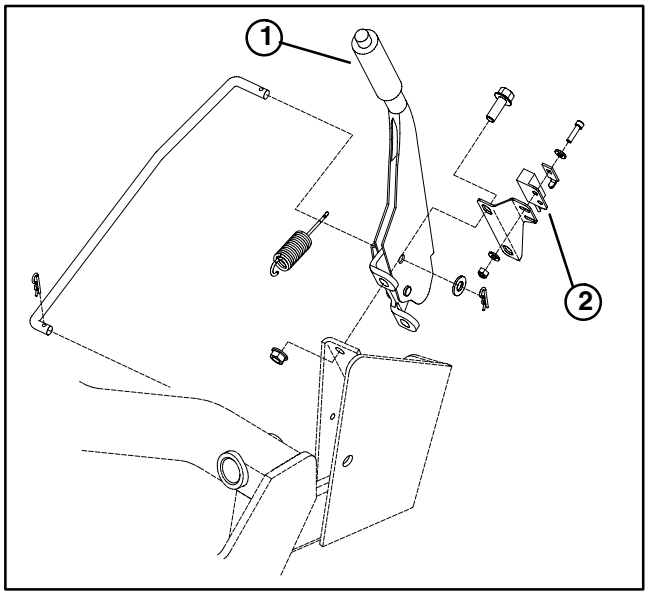

Figure 23

1. **Parking brake lever**
2. **Brake switch**

Cutting Unit Interlock Switch

This switch is normally open and closes when the cutting units are lowered. The switch and its electrical connector are located behind and below the hydraulic manifold on the cylinder support bracket.

1. Disconnect switch electrical connector.

2. With the cutting units lowered, check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals. There should be continuity across the switch.

3. Raise the cutting units and check the continuity of the switch. There should be no continuity across the switch with the lift cylinder extended (cutting units raised).

4. Connect switch electrical connector.

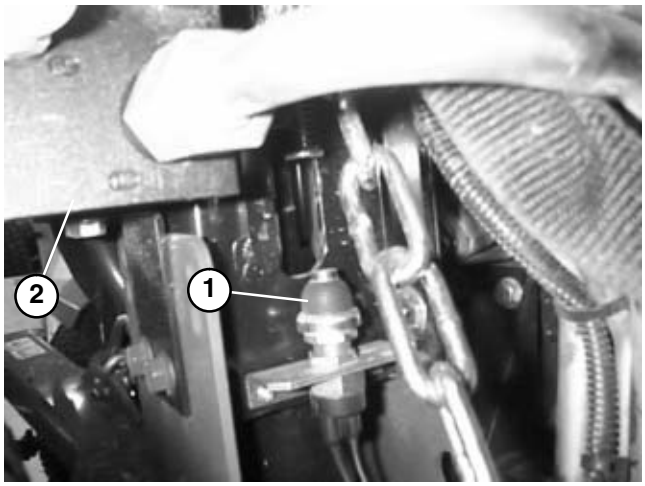

Figure 24

1. **Cutting unit interlock switch**
2. **Hydraulic manifold**

Backlap Switch

The backlap switch is attached to the hydraulic manifold. It is normally open and is closed when the backlap knob is turn clockwise to the backlap position.

The Standard Control Module monitors the operation of the backlap switch. If the ignition switch is in the ON position and the backlap knob is turned to the backlap position, the Module backlap input LED should be illuminated.

Backlap Switch Test

1. Locate backlap switch on hydraulic manifold. Disconnect the backlap switch electrical connector.

2. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.

3. With the engine off, turn the backlap knob clockwise to the backlap position while watching the multimeter. Continuity should be made as the switch closes.

4. Turn the backlap knob counterclockwise to the mow position while watching the multimeter. Continuity should be broken as the switch opens.

5. Reconnect the electrical connector.

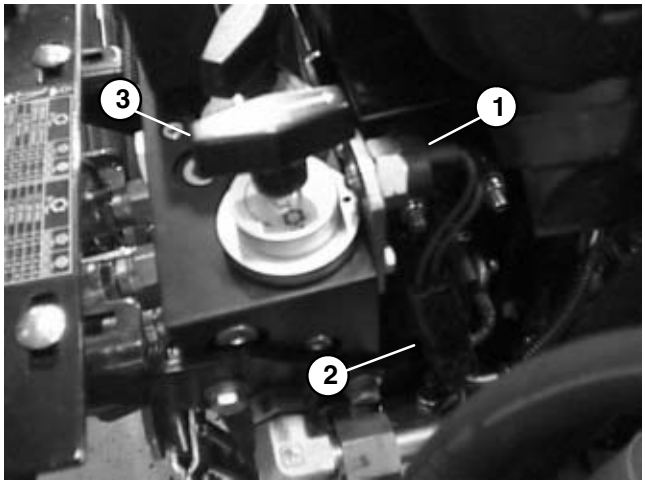

Figure 25

1. **Backlap switch**
2. **Connector**
3. **Backlap knob**

Fuses

The fuse block is located on the back of the instrument panel (Fig. 26).

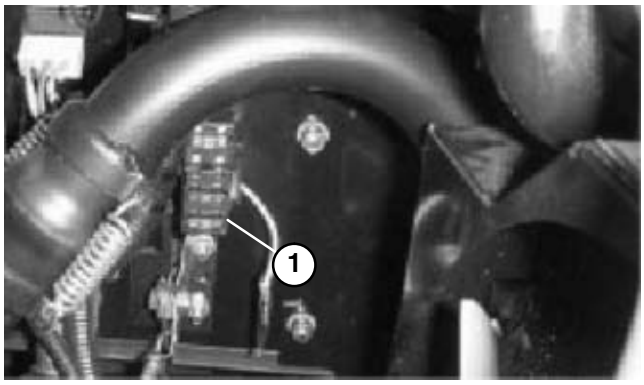

Figure 26

1. **Fuse block**

Identification, Function, and Wiring

The fuses are held in the fuse block. Use Figure 27 to identify each individual fuse and its correct amperage. Each fuse holder has the following functions and wire connected to it.

Fuse 1 (15 Amp)

A. Supplies power to ignition switch terminal B.

B. Has orange wire and red wire (battery).

Fuse 2 (option)

A. Supplies power to optional lights.

B. Has blue wire and red wire.

C. **DO NOT** use fuse greater than 15 amp.

Fuse 3 (10 Amp)

A. Supplies power from ignition switch terminal S.

B. Has violet wire and tan wire.

Fuse 4 (10 Amp)

A. Supplies power from ignition switch terminal I.

B. Has pink wire and yellow wire.

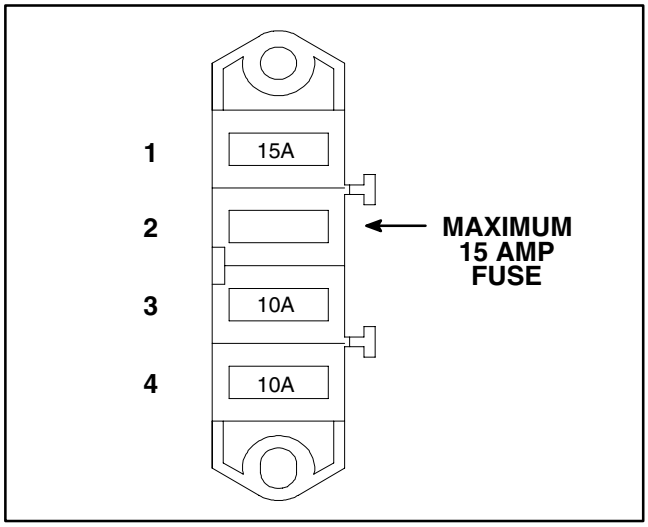

Figure 27

Testing

Remove fuses from the fuse block for testing. Fuse should have continuity between fuse terminals.

Diode Assembly

Diode D3 is used for circuit protection from voltage spikes when the hydraulic valve solenoid is de–energized. The diode plugs into the wiring harness (see Wire Harness Drawings in Chapter 8 – Electrical Diagrams).

Diode Test

The diode (Fig. 28) can be tested using a digital multimeter (diode test or ohms setting) and the table below.

Multimeter Red Lead (+) on Terminal	Multimeter Black Lead (–) on Terminal	Continuity
Female	Male	YES
Male	Female	NO

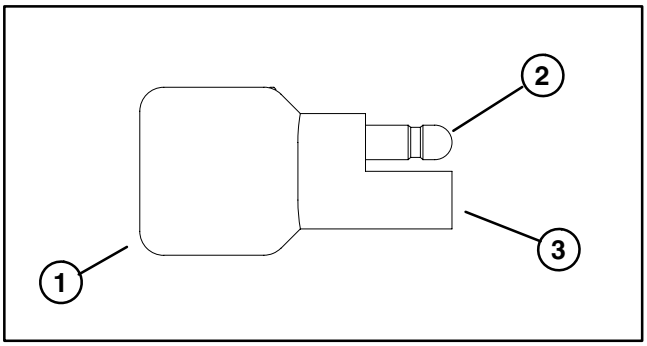

Figure 28

1. **Diode**
2. **Male terminal**
3. **Female terminal**

Service and Repairs

NOTE: See the Briggs & Stratton/Daihatsu Engine Repair Manual for more component repair information.

Battery Storage

If the machine will be stored for more than 30 days:

1. Remove the battery and charge it fully (see Battery Service).

2. Either store battery on a shelf or on the machine.

3. Leave cables disconnected if the battery is stored on the machine.

4. Store battery in a cool atmosphere to avoid quick deterioration of the battery charge.

5. To help prevent the battery from freezing, make sure it is fully charged (see Battery Service).

Battery Care

1. Battery electrolyte level must be properly maintained. The top of the battery must be kept clean. If the machine is stored in a location where temperatures are extremely high, the battery will run down more rapidly than if the machine is stored in a location where temperatures are cool.

WARNING

Wear safety goggles and rubber gloves when working with electrolyte. Charge battery in a well ventilated place so gasses produced while charging can dissipate. Since the gases are explosive, keep open flames and electrical sparks away from the battery; do not smoke. Nausea may result if the gases are inhaled. Unplug charger from electrical outlet before connecting or disconnecting charger leads to or from battery posts.

IMPORTANT: Do not remove battery fill caps while cleaning.

2. Check battery condition weekly or after every 50 hours of operation. Keep terminals and entire battery case clean because a dirty battery will discharge slowly.

   A. Clean battery by washing entire case with a solution of baking soda and water. Rinse with clear water.

   B. Coat battery posts and cable connectors with skin–over grease (Toro Part No. 505-47) or petroleum jelly to prevent corrosion.

3. Battery cables must be tight on terminals to provide good electrical contact.

WARNING

Connecting cables to the wrong post could result in personal injury and/or damage to the electrical system.

4. If corrosion occurs at terminals, disconnect cables. Always disconnect negative (–) cable first. Clean clamps and terminals separately. Reconnect cables with positive (+) cable first. Coat battery posts and cable connectors with skin–over grease (Toro Part No. 505-47) or petroleum jelly to prevent corrosion.

5. Check electrolyte level every 25 operating hours, and every 30 days if machine is in storage.

6. Maintain cell level with distilled or demineralized water. Do not fill cells above the fill line.

Battery Service

The battery is the heart of the electrical system. With regular and proper service, battery life can be extended. Additionally, battery and electrical component failure can be prevented.

CAUTION

When working with batteries, use extreme caution to avoid slashing or spilling electrolyte. Electrolyte can destroy clothing and burn skin or eyes. Always wear safety goggles and a face shield when working with batteries.

Electrolyte Specific Gravity
Fully charged: 1.265 corrected to 80ºF (26.7ºC)
Discharged: less than 1.240

Battery Specifications
BCI Group Size 55
585 CCA at 0º F (–18º C)
Reserve Capacity of 95 minutes at 80ºF (27ºC)

Dimensions (including terminal posts and handle)

Length	9.0 inches (22.9 cm)
Width	6.0 inches (15.2 cm)
Height	8.5 inches (21.6 cm)

Removal and Installation (Fig. 29)

1. Loosen and remove negative cable from battery. After negative cable is removed, loosen and remove positive cable.

2. Loosen flange nuts that secure battery bracket. Slide bracket away from battery.

3. Carefully remove battery from machine.

4. Install battery in reverse order making sure to connect positive cable to battery before connecting negative cable.

NOTE: Before connecting the negative (ground) cable, connect a digital multimeter (set to amps) between the negative battery post and the negative (ground) cable connector. The reading should be less than 0.1 amp. If the reading is 0.1 amp or more, the unit's electrical system should be tested and repaired.

Inspection, Maintenance, and Testing

1. Perform following inspections and maintenance:

   A. Check for cracks. Replace battery if cracked or leaking.

   B. Check battery terminal posts for corrosion. Use wire brush to clean corrosion from posts.

Figure 29

1. **Negative battery cable** 2. **Positive battery cable**

IMPORTANT: Before cleaning the battery, tape or block vent holes to the filler caps and make sure the caps are on tightly.

   C. Check for signs of wetness or leakage on the top of the battery which might indicate a loose or missing filler cap, overcharging, loose terminal post, or overfilling. Also, check battery case for dirt and oil. Clean the battery with a solution of baking soda and water, then rinse it with clean water.

   D. Check that the cover seal is not broken away. Replace the battery if the seal is broken or leaking.

   E. Check the electrolyte level in each cell. If the level is below the tops of the plates in any cell, fill all cells with **distilled water** between the minimum and maximum fill lines. Charge at 15 to 25 amps for 15 minutes to allow sufficient mixing of the electrolyte.

2. Conduct a hydrometer test of the battery electrolyte.

IMPORTANT: Make sure the area around the cells is clean before opening the battery caps.

   A. Measure the specific gravity of each cell with a hydrometer. Draw electrolyte in and out of the hydrometer barrel prior to taking a reading to warm–up the hydrometer. At the same time take the temperature of the cell.

B. Temperature correct each cell reading. For each 10ºF (5.5ºC) above 80ºF (26.7ºC) add 0.004 to the specific gravity reading. For each 10ºF (5.5ºC) below 80ºF (26.7ºC) subtract 0.004 from the specific gravity reading.

Example: Cell Temperature 100ºF
Cell Gravity 1.245
100ºF minus 80ºF equals 20ºF
(37.7ºC minus 26.7ºC equals 11.0ºC)
20ºF multiply by 0.004/10ºF equals 0.008
(11ºC multiply by 0.004/5.5ºC equals 0.008)
ADD (conversion above) 0.008
Correction to 80ºF (26.7ºC) 1.253

C. If the difference between the highest and lowest cell specific gravity is 0.050 or greater or the lowest cell specific gravity is less than 1.225, charge the battery. Charge at the recommended rate and time given in **Charging** or until all cells specific gravity is 1.225 or greater with the difference in specific gravity between the highest and lowest cell less than 0.050. If these charging conditions can not be met, replace the battery.

3. Perform a high–discharge test with an adjustable load tester.

This is one of the most reliable means of testing a battery as it simulates the cold–cranking test. A commercial battery load tester is **required** to perform this test.

CAUTION

Follow the manufacturer's instructions when using a battery tester.

A. Check the voltage across the battery terminals prior to testing the battery. If the voltage is less than 12.4 VDC, recharge the battery.

B. If the battery has been charged, apply a 150 amp load for 15 seconds to remove the surface charge. Use a battery load tester following the manufacturer's instructions.

C. Make sure battery terminals are free of corrosion.

D. Measure the temperature of the center cell.

E. Connect a battery load tester to the battery terminals **following the manufacturer's instructions**. Connect a digital multimeter to the battery terminals.

F. Apply a test load of one half the Cranking Performance (see Battery Specifications) rating of the battery for 15 seconds.

G. Take a voltage reading at 15 seconds, then remove the load.

H. Using the table below, determine the minimum voltage for the cell temperature reading:

Minimum Voltage	Battery Electrolyte Temperature	
9.6	70ºF (and up)	21.1ºC (and up)
9.5	60ºF	15.6ºC
9.4	50ºF	10.0ºC
9.3	40ºF	4.4ºC
9.1	30ºF	–1.1ºC
8.9	20ºF	–6.7ºC
8.7	10ºF	–12.2ºC
8.5	0ºF	–17.8ºC

I. If the test voltage is below the minimum, replace the battery. If the test voltage is at or above the minimum, return the battery to service.

Charging

To minimize possible damage to the battery and allow the battery to be fully charged, the slow charging method is presented here. This charging method can be accomplished with a constant current battery charger which is available in most shops.

CAUTION

Follow the manufacturer's instructions when using a battery charger.

NOTE: Using specific gravity of the battery cells is the most accurate method of determining battery condition.

1. Determine the battery charge level from either its specific gravity or open circuit voltage.

Battery Charge Level	Specific Gravity	Open Circuit Voltage
100%	1.265	12.68
75%	1.225	12.45
50%	1.190	12.24
25%	1.155	12.06
0%	1.120	11.89

2. Determine the charging time and rate **using the manufacturer's battery charger instructions** or the following table.

Battery Reserve Capacity (Minutes)	Battery Charge Level (Percent of Fully Charged)			
	75%	50%	25%	0%
80 or less	3.8 hrs @ 3 amps	7.5 hrs @ 3 amps	11.3 hrs @ 3 amps	15 hrs @ 3 amps
81 to 125	5.3 hrs @ 4 amps	10.5 hrs @ 4 amps	15.8 hrs @ 4 amps	21 hrs @ 4 amps
126 to 170	5.5 hrs @ 5 amps	11 hrs @ 5 amps	16.5 hrs @ 5 amps	22 hrs @ 5 amps
171 to 250	5.8 hrs @ 6 amps	11.5 hrs @ 6 amps	17.3 hrs @ 6 amps	23 hrs @ 6 amps
above 250	6 hrs @ 10 amps	12 hrs @ 10 amps	18 hrs @ 10 amps	24 hrs @ 10 amps

CAUTION

Do not charge a frozen battery because it can explode and cause injury. Let the battery warm to 60°F (15.5° C) before connecting to a charger.

Charge the battery in a well–ventilated place to dissipate gases produced from charging. These gases are explosive; keep open flame and electrical spark away from the battery. Do not smoke. Nausea may result if the gases are inhaled. Unplug the charger from the electrical outlet before connecting or disconnecting the charger leads from the battery posts.

3. **Following the manufacturer's instructions**, connect the charger cables to the battery. Make sure a good connection is made.

4. Charge the battery **following the manufacturer's instructions**.

5. Occasionally check the temperature of the battery electrolyte. If the temperature exceeds 125ºF (51.6ºC) or the electrolyte is violently gassing or spewing, the charging rate must be lowered or temporarily stopped.

6. Three hours prior to the end of the charging, measure the specific gravity of a battery cell once per hour. The battery is fully charged when the cells are gassing freely at a low charging rate and there is less than a 0.003 change in specific gravity for three consecutive readings.

Solenoid Valve Coil

The solenoid valve coil on the reel drive (Fig. 30) and 3WD hydraulic manifold, if equipped, (Fig. 31) can be easily replaced without opening the hydraulic system.

Removal

1. Disconnect the electrical connector.

2. Remove the nut from the spool assembly.

3. Slide the coil assembly and o–rings from the spool assembly. Discard the coil assembly and o–rings.

4. Clean any corrosion or dirt from the spool assembly.

Installation

1. Slide new coil assembly onto the spool assembly making sure that o–ring is installed at each end of coil. Align the coil assembly evenly with the manifold body.

2. Apply medium strength thread–locking compound to the threads of the spool. Install the nut onto the spool assembly and torque as follows (do not over tighten):

   A. Torque nut for reel drive solenoid from 2 to 5 ft–lb (2.7 to 6.8 N–m).

   B. Torque nut for 3WD solenoid from 4 to 6 ft–lb (5 to 8 N–m).

3. Connect the solenoid to the machine wiring harness.

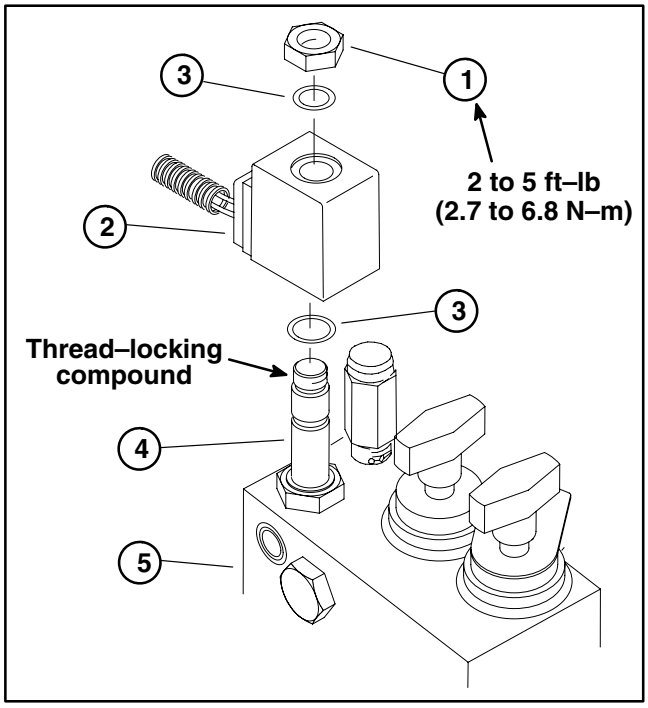

Figure 30

1. Nut
2. Coil assembly
3. O–ring
4. Spool assembly
5. Reel drive manifold

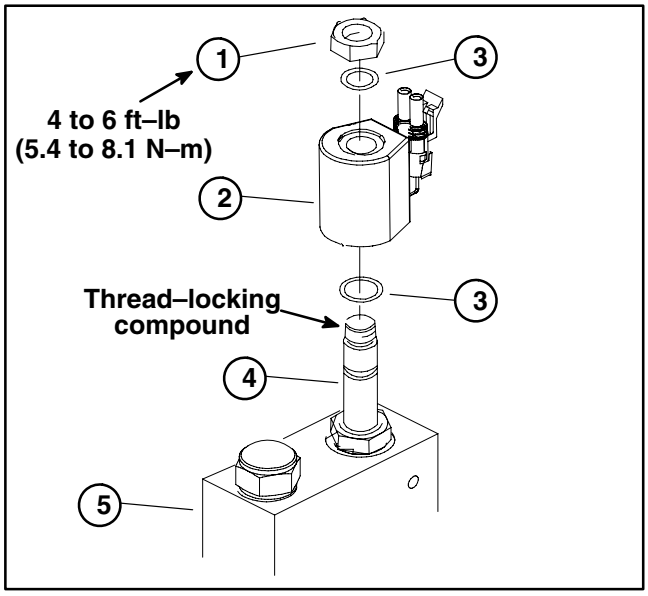

Figure 31

1. Nut
2. Coil assembly
3. O–ring
4. Spool assembly
5. 3WD manifold

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Chapter 6

Chassis

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Specifications

Item	Description
Front tire pressure (20 x 10–8, 4 ply, tubeless)	16 to 20 PSI (1.1 to 1.38 bar)
Rear tire pressure (20 x 8–8, 4 ply, tube type)	16 to 20 PSI (1.1 to 1.38 bar)
Front and rear wheel lug nut torque	45 to 65 ft–lb (61 to 88 N–m)
Front hub nut torque	250 to 400 ft–lb (339 to 542 N–m)
3WD rear hub nut torque	250 to 400 ft–lb (339 to 542 N–m)

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Rear Wheel (Standard 2 Wheel Drive)

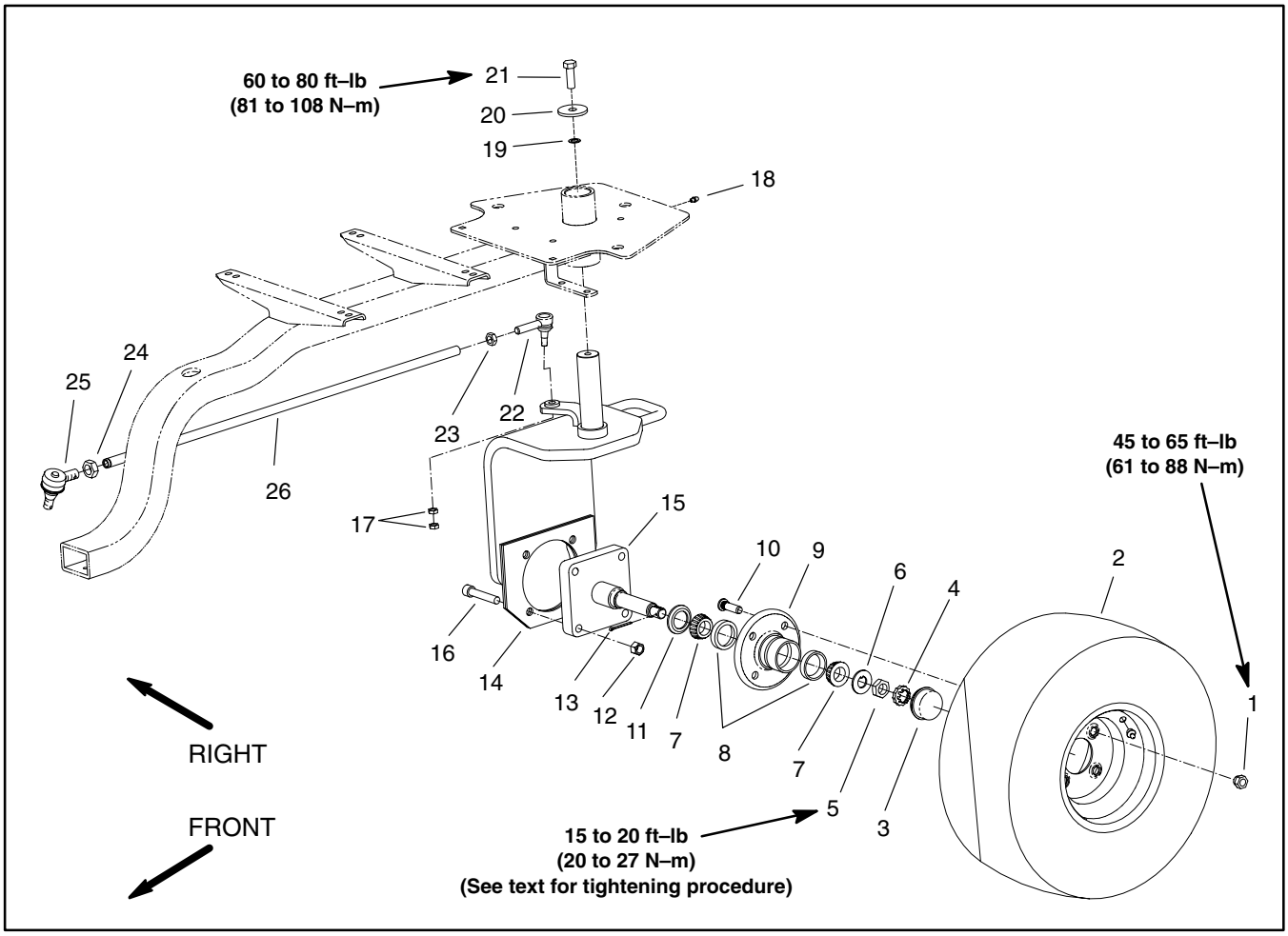

Figure 1

1. Lug nut
2. Wheel assembly
3. Dust cap
4. Lock nut retainer
5. Jam nut
6. Tab washer
7. Bearing cone
8. Bearing cup
9. Wheel hub
10. Drive stud
11. Seal
12. Lock nut
13. Cotter pin
14. Rear wheel fork
15. Hub
16. Socket head screw
17. Jam nut
18. Grease fitting
19. Lock washer
20. Thrust washer
21. Cap screw
22. Ball joint
23. Jam nut (left hand thread)
24. Jam nut
25. Ball joint
26. Steering tube

Removal (Fig. 1)

1. Park machine on a level surface, lower cutting units, stop engine, engage parking brake, and remove key from the ignition switch.

2. Chock front wheels. Raise rear wheel using a jack or hoist. Block rear of machine.

3. Remove lug nuts and remove rear wheel.

4. Remove dust cap from hub. Remove cotter pin, lock nut retainer, jam nut, and tab washer to allow removal of wheel hub and bearings. Pull wheel hub with bearings and seal from machine.

5. If necessary, remove seal and bearings from wheel hub.

6. Inspect bearing cups in wheel hub for wear or damage. If bearing cups are damaged, replace the wheel hub.

Installation (Fig. 1)

1. If seal and inner bearing were removed from the wheel hub, place greased bearing cone into inner bearing cup. Install new seal.

2. Slide wheel hub onto machine. Position greased outer bearing and tab washer onto shaft.

3. Install jam nut onto shaft and tighten. Back off jam nut and then, while rotating wheel hub, torque nut from 15 to 20 ft–lb (20 to 27 N–m).

4. Install lock nut retainer, cotter pin, and dust cap.

5. Install wheel and secure with lug nuts.

6. Tighten lug nuts evenly in a crossing pattern to a torque of 45 to 65 ft–lb (61 to 88 N–m).

Rear Wheel (Optional 3 Wheel Drive)

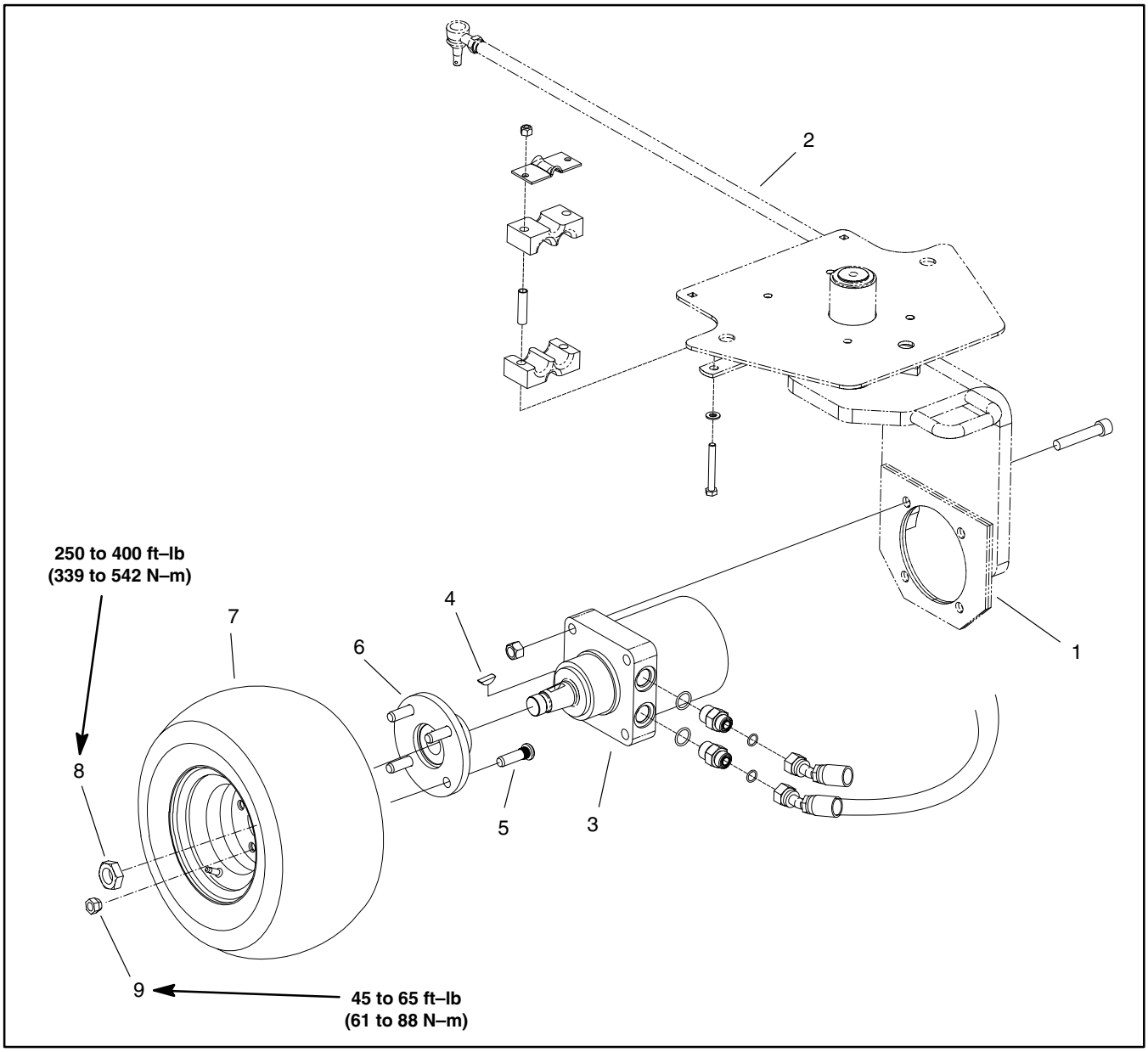

Figure 2

1. **Rear wheel fork**
2. **Steering tube assembly**
3. **Rear wheel motor**
4. **Key**
5. **Drive stud**
6. **Wheel hub**
7. **Wheel assembly**
8. **Lock nut**
9. **Lug nut**

Removal (Fig. 2)

1. Park machine on a level surface, lower cutting units, stop engine, engage parking brake, and remove key from the ignition switch.

2. Chock front wheels. Raise rear wheel using a jack or hoist. Block rear of machine.

3. Remove lug nuts and remove rear wheel.

4. Remove lock nut from wheel motor shaft.

IMPORTANT: DO NOT hit wheel hub (6) with a hammer during removal or installation. Hammering may cause damage to the wheel motor.

5. Use a puller to remove the wheel hub. Remove the key from the wheel motor shaft.

6. Remove rust from all parts with a wire brush prior to installation. Clean all parts. Replace any worn or damaged components.

Installation (Fig. 2)

1. Install key and wheel hub onto the wheel motor shaft.

2. Install lock nut to wheel motor shaft and tighten to a torque of 250 to 400 ft–lb (339 to 542 N–m).

3. Install wheel assembly and secure the lug nuts to the drive studs.

4. Tighten lug nuts evenly in a crossing pattern to a torque of 45 to 65 ft–lb (61 to 88 N–m).

Front Wheels and Brakes

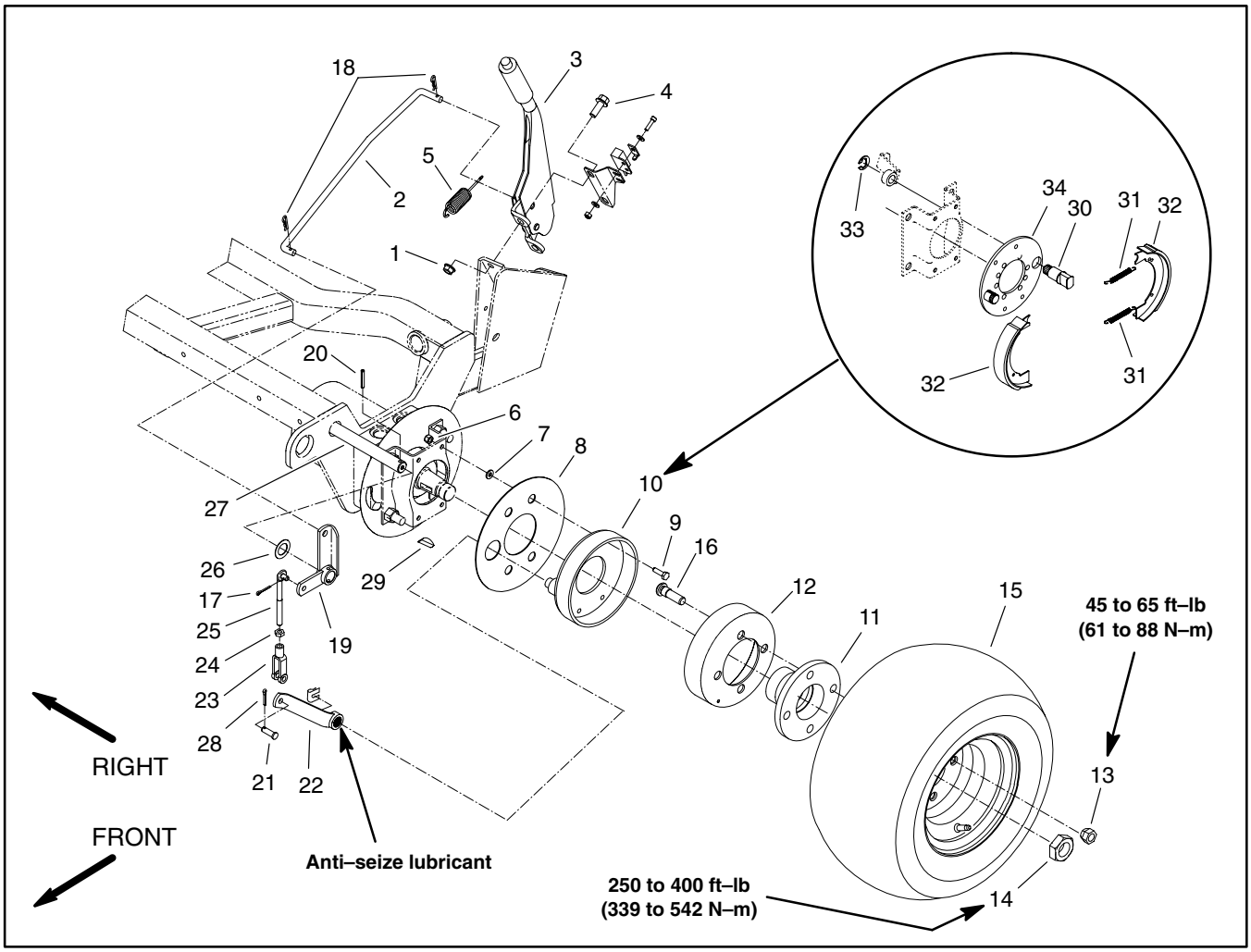

Figure 3

1. Flange nut
2. Brake rod
3. Parking brake lever
4. Flange head screw
5. Extension spring
6. Lock nut
7. Flat washer
8. Brake grass shield
9. Cap screw
10. Brake assembly
11. Wheel hub
12. Brake drum
13. Lug nut
14. Lock nut
15. Wheel assembly
16. Drive stud
17. Cotter pin
18. Hair pin
19. Brake lever (LH shown)
20. Roll pin
21. Yoke pin
22. Brake lever
23. Yoke
24. Nut
25. Adjusting rod
26. Thrust washer
27. Brake shaft
28. Cotter pin
29. Key
30. Brake cam shaft
31. Return spring
32. Brake shoe
33. E–ring
34. Backing plate

Removal

1. Park machine on a level surface, lower cutting units, stop engine, and remove key from the ignition switch.

2. Make sure brake is disengaged.

3. Lift front wheel off the ground using a jack. Block front and rear of other wheels.

4. Remove lug nuts (13) and wheel assembly (15). Remove lock nut (14) from wheel motor shaft.

IMPORTANT: DO NOT hit wheel hub (11) with a hammer during removal or installation. Hammering may cause damage to the wheel motor.

5. Use a puller to remove the wheel hub (11) and brake drum (12). Remove the key (34) from the wheel motor shaft.

6. Remove brake return springs (31) from brake shoes (32). Remove brake shoes from backing plate (29).

7. Remove cotter pin (28) from the yoke pin (21). Remove yoke pin from the brake lever (22) and separate yoke (23) from the brake lever (Fig. 4).

8. Remove cap screws (9) and lock nuts (6) holding the backing plate (36) and brake grass shield (8) to the brake bracket.

9. Remove backing plate (29), flat washers (7), and brake grass shield (15) from the brake bracket.

10. If brake lever (22) is removed from brake cam shaft (30), match mark lever and shaft before disassembly to allow for correct reassembly alignment.

11. Remove rust from all parts with a wire brush prior to installation. Clean all parts. Inspect brake shoe contact surfaces of the brake drum for excessive wear. Replace any worn or damaged parts.

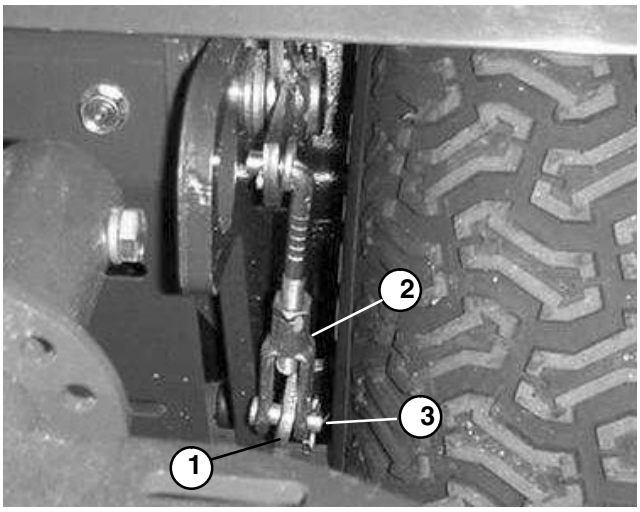

Figure 4

1. **Brake lever**
2. **Yoke**
3. **Yoke pin**

Installation

1. If brake lever was removed from brake cam shaft, apply anti–seize lubricant to splines of cam shaft before installing brake lever.

2. Secure flat washers (7), brake grass shield (15), and backing plate (29) to the brake bracket with the cap screws (9) and lock nuts (6). Tighten fasteners.

3. Connect brake lever (22) to the yoke (23). Install yoke pin (21) through the brake lever and yoke. Install and lock cotter pin (28) into the yoke pin (Fig. 4).

4. Install brake shoes (32) onto the backing plate (29). Install brake return springs (31) into the holes on each end of the brake shoes. Springs should be installed in opposite directions of each other.

5. Mount key (34) in the wheel motor shaft, then install the wheel hub (11) and brake drum (12) onto the wheel motor shaft.

6. Install the lock nut (14) onto the wheel motor shaft and torque from 250 to 400 ft–lb (339 to 542 N–m).

7. Check and adjust brakes (see Traction Unit Operator's Manual).

8. Check operation of brake switch (see Traction Unit Operator's Manual). Adjust brake switch if necessary (see Adjustments in Chapter 5 – Electrical System).

9. Install wheel assembly and secure with lug nuts. Tighten lug nuts evenly in a crossing pattern to a torque from 45 to 65 ft–lb (61 to 88 N–m).

Standard Seat

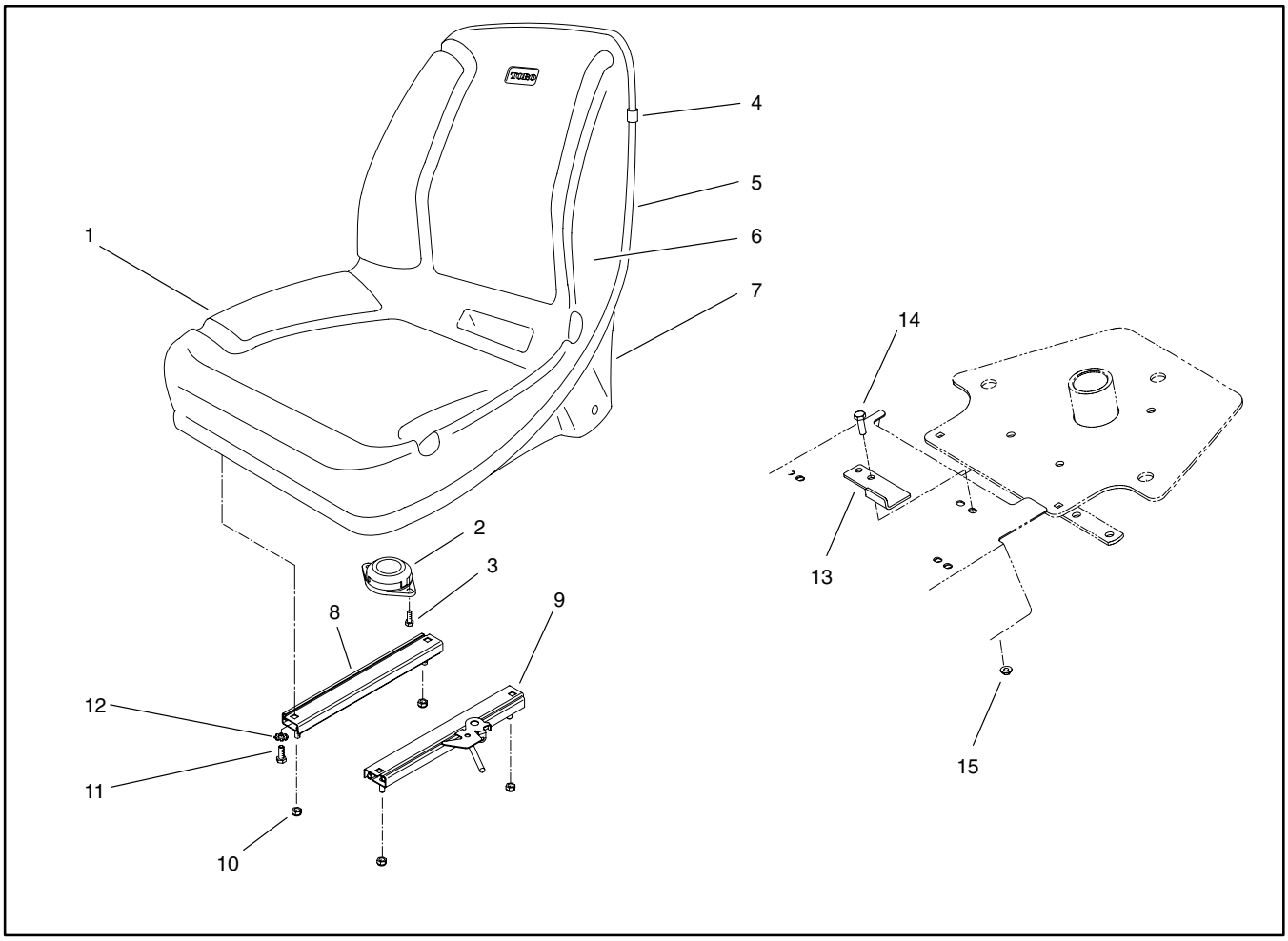

Figure 5

1. **Seat (incl. 2 thru 7)**
2. **Seat switch**
3. **Cap screw**
4. **Edging clip**
5. **Edging**
6. **Seat cushion**
7. **Seat shell**
8. **Seat adjuster**
9. **Seat adjuster with latch**
10. **Flange hex nut**
11. **Cap screw**
12. **Lock washer**
13. **Seat stop**
14. **Cap screw**
15. **Flange nut**

Removal

1. Park machine on a level surface, lower cutting units, stop engine, engage parking brake, and remove key from the ignition switch.

2. Remove four cap screws and lock nuts securing the seat to the machine frame.

3. Disconnect electrical connector from the seat switch. Separate seat from the frame.

4. Remove seat parts as necessary to make repairs using Figure 5 as a guide.

Installation

1. Install any new seat parts using Figure 5 as a guide.

2. Position seat to the machine frame.

3. Connect electrical connector to the seat switch.

4. Secure seat to the frame with four cap screws and lock nuts.

Suspension Seat

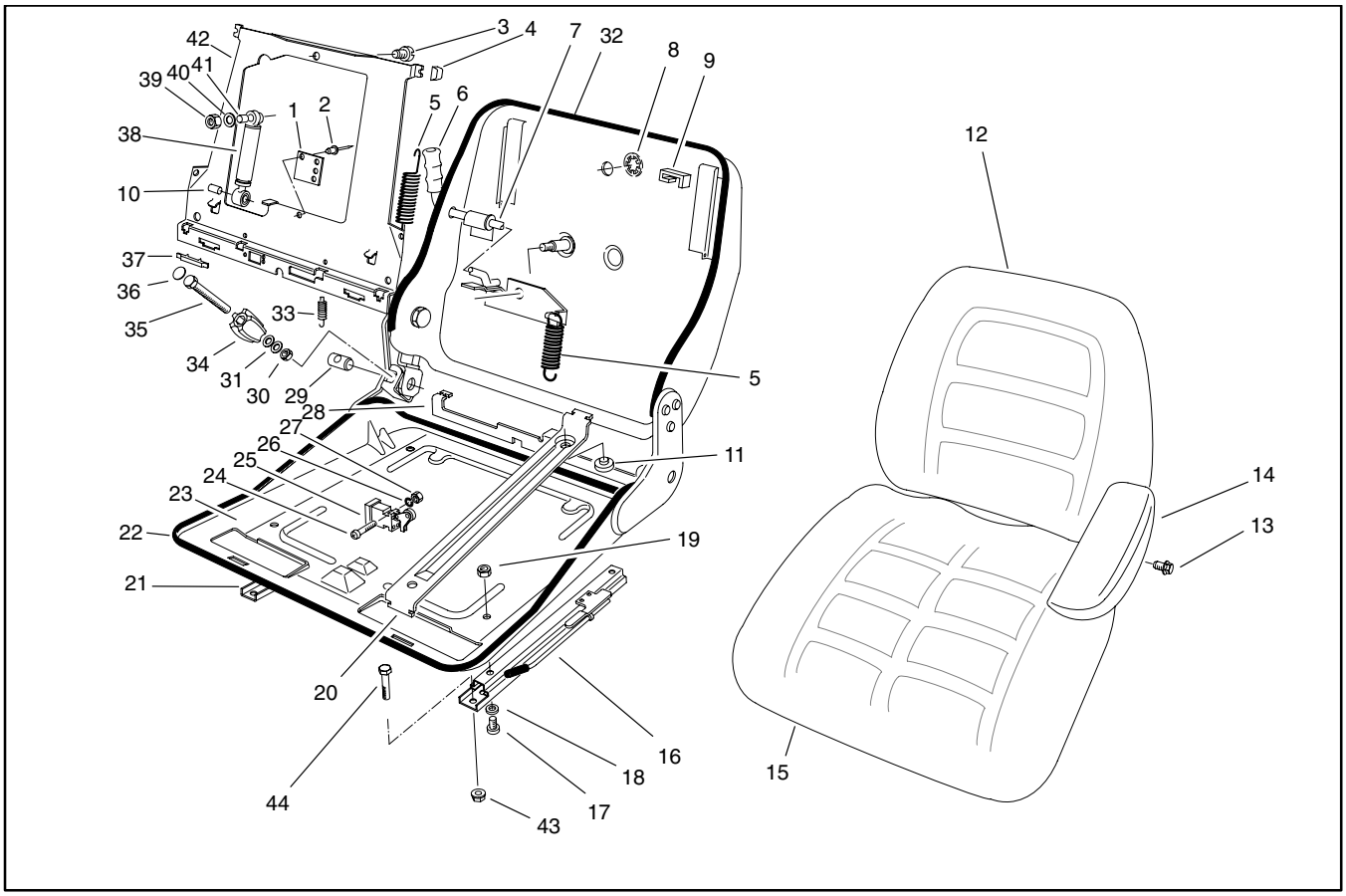

Figure 6

1. **Plate**
2. **Rivet**
3. **Screw**
4. **Wear parts kit (incl. 8 thru 11)**
5. **Tension spring set**
6. **Handle grip**
7. **Adjusting lever**
8. **Cover**
9. **Bumper**
10. **Bushing**
11. **Pad**
12. **Backrest cushion**
13. **Hex head machine screw**
14. **Arm rests**
15. **Bottom cushion**
16. **Adjusting rail (LH)**
17. **Screw**
18. **Washer**
19. **Nut**
20. **Swing arm assembly (incl. 28 & 42)**
21. **Adjusting rail (RH)**
22. **Bottom trim**
23. **Seat frame**
24. **Screw**
25. **Seat switch (incl. 24, 26, & 27)**
26. **Spring washer**
27. **Nut**
28. **Back plate pivot**
29. **Threaded clevis**
30. **Nut**
31. **Washer**
32. **Backrest trim**
33. **Tension spring set**
34. **Spindle adjuster (incl. 29 thru**
35. **Screw**
36. **Cover**
37. **Clamp**
38. **Shock absorber**
39. **Nut**
40. **Washer**
41. **Bushing kit (incl. 39 & 40)**
42. **Backrest plate**
43. **Hex flange nut**
44. **Cap screw**

Removal

1. Park machine on a level surface, lower cutting units, stop engine, engage parking brake, and remove key from the ignition switch.

2. Remove four cap screws and lock nuts securing the seat to the frame.

3. Disconnect electrical connector from the seat switch. Separate seat from the frame.

4. Remove seat parts as necessary to make repairs using Figure 6 as a guide.

Installation

1. Install any new seat parts using Figure 6 as a guide.

2. Position seat to the machine frame.

3. Connect electrical connector to the seat switch.

4. Secure seat to the frame with cap screws and lock nuts.

Steering Assembly

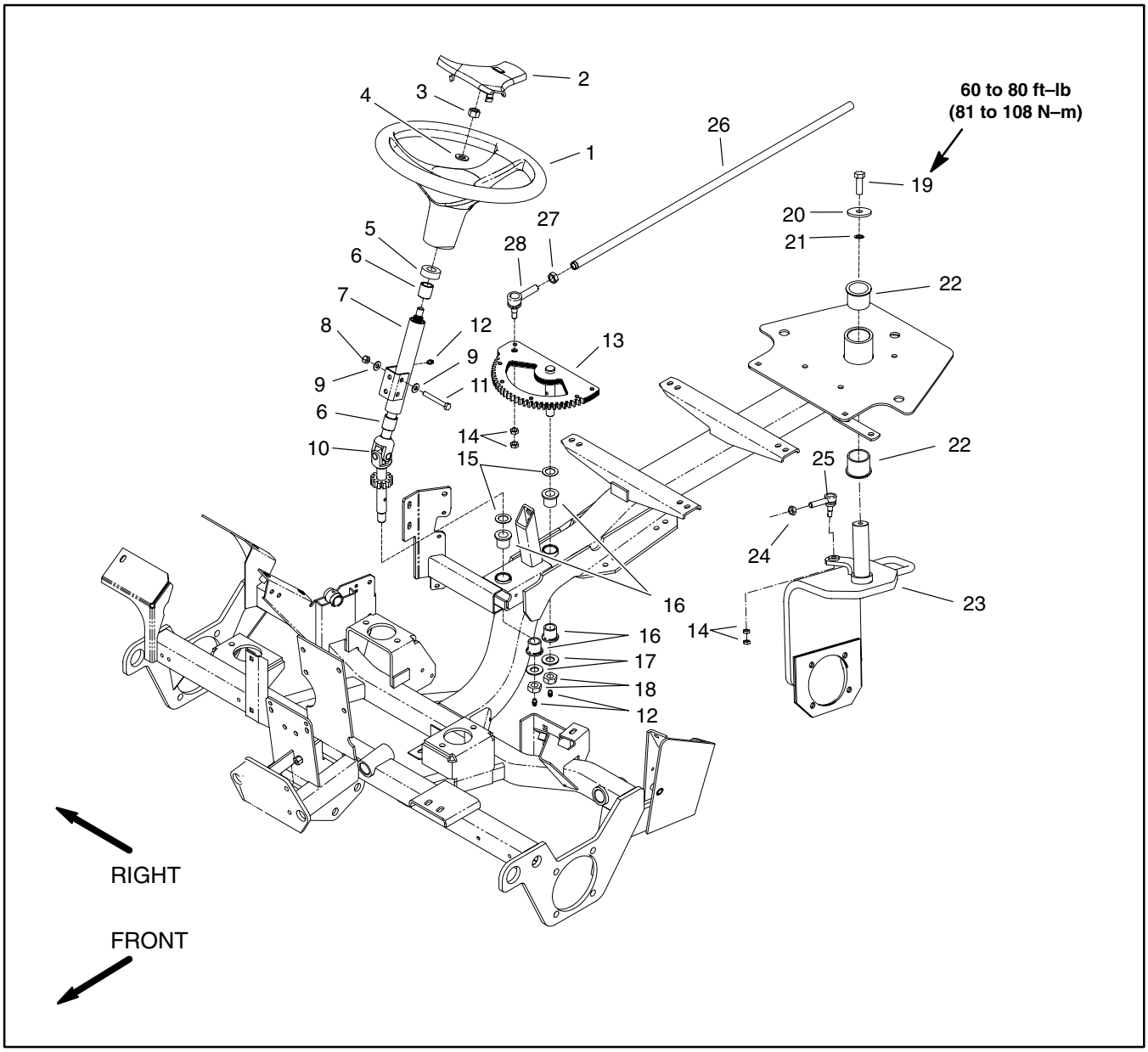

Figure 7

1. Steering wheel
2. Steering wheel cover
3. Lock nut
4. Flat washer
5. Dust cover
6. Bushing
7. Steering column
8. Lock nut
9. Flat washer
10. Steering shaft & gear
11. Cap screw
12. Grease fitting
13. Sector gear
14. Jam nut
15. Thrust washer
16. Flange bushing
17. Flat washer
18. Lock nut
19. Cap screw
20. Thrust washer
21. Lock washer
22. Flange bushing
23. Rear wheel fork
24. Jam nut (LH thread)
25. Ball joint
26. Steering tube
27. Jam nut
28. Ball joint

Disassembly

1. Park machine on a level surface, lower cutting units, stop engine, engage parking brake, and remove key from the ignition switch.

2. Disassemble steering assembly as needed using Figure 7 as a guide.

Assembly

1. Assemble steering assembly using Figure 7 as a guide.

   A. Shim steering shaft (with gear) and sector gear with thrust washers as needed to align gear tops. Gears should not contact flange bushings.

   B. Adjust steering tube ball joints equally so that steering sector gear and rear wheel fork are perpendicular to the frame.

   C. If rear wheel fork was removed, secure fork to frame with washers and cap screw. Torque cap screw from 60 to 80 ft–lb (81 to 108 N–m). Make sure that fork rotates freely after cap screw has been tightened.

2. After assembly is complete, make sure that steering components do not contact hoses or wires.

Front Lift Arms

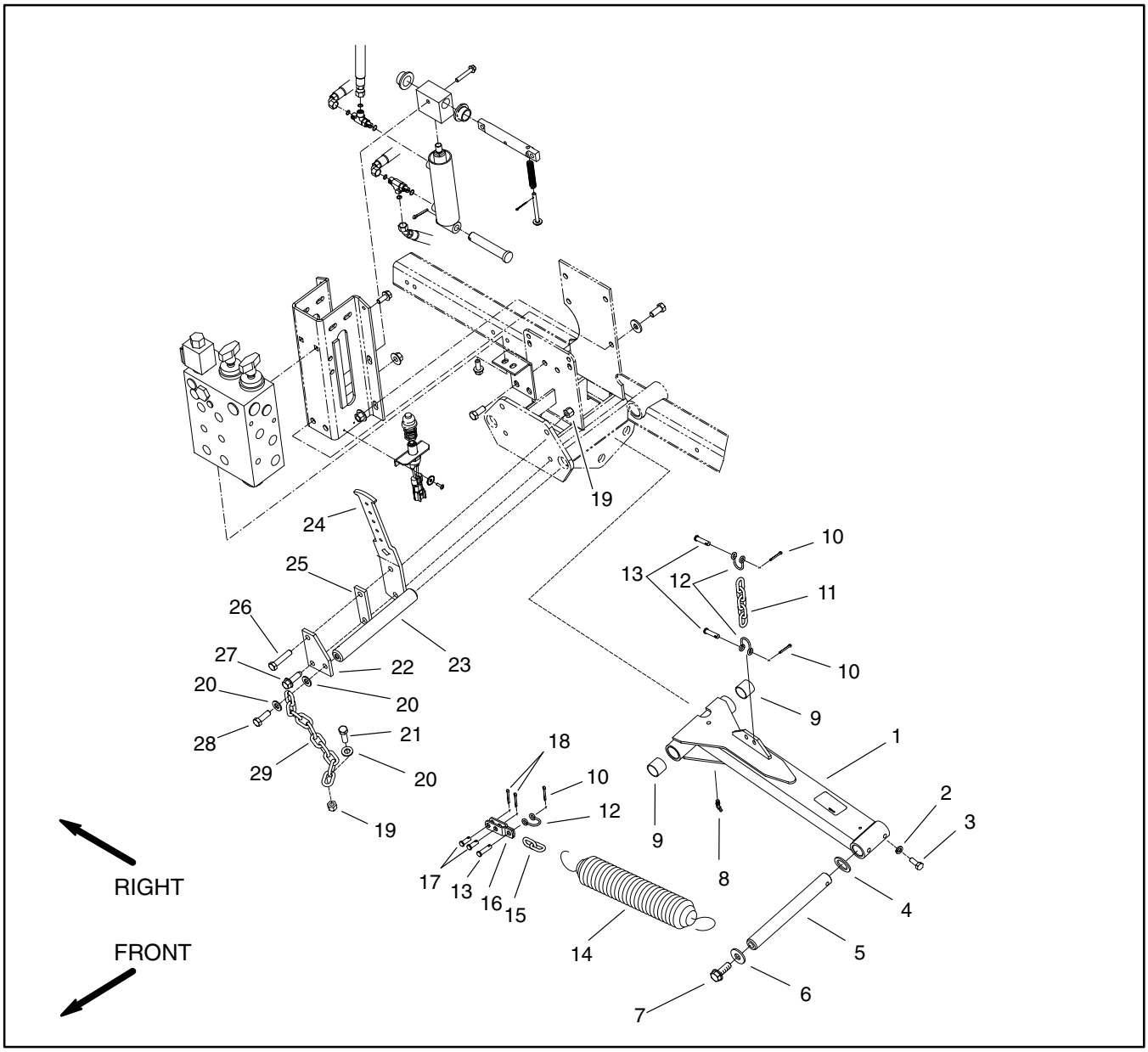

Figure 8

1. **Lift arm (LH shown)**
2. **Lock washer**
3. **Cap screw**
4. **Thrust washer**
5. **Cutting unit pivot shaft**
6. **Flat washer**
7. **Flange head screw**
8. **Grease fitting**
9. **Bushing**
10. **Cotter pin**
11. **Chain**
12. **Shackle**
13. **Clevis pin**
14. **Spring**
15. **Chain (if used)**
16. **Shackle**
17. **Clevis pin**
18. **Cotter pin**
19. **Lock nut**
20. **Flat washer**
21. **Cap screw**
22. **Reinforcement plate**
23. **Lift arm pivot shaft**
24. **Spring tension arm**
25. **Spacer**
26. **Cap screw**
27. **Self tapping screw**
28. **Cap screw**
29. **Chain**

Disassembly

1. Remove cutting unit from lift arm (see Traction Unit Operator's Manual).

2. Remove front lift arm components from machine using Figure 8 as a guide.

Assembly

1. Install front lift arm components to machine using Figure 8 as a guide. Mount cutting unit to lift arm (see Traction Unit Operator's Manual).

2. See Operator's Manual for adjustment procedures.

Rear Lift Arm

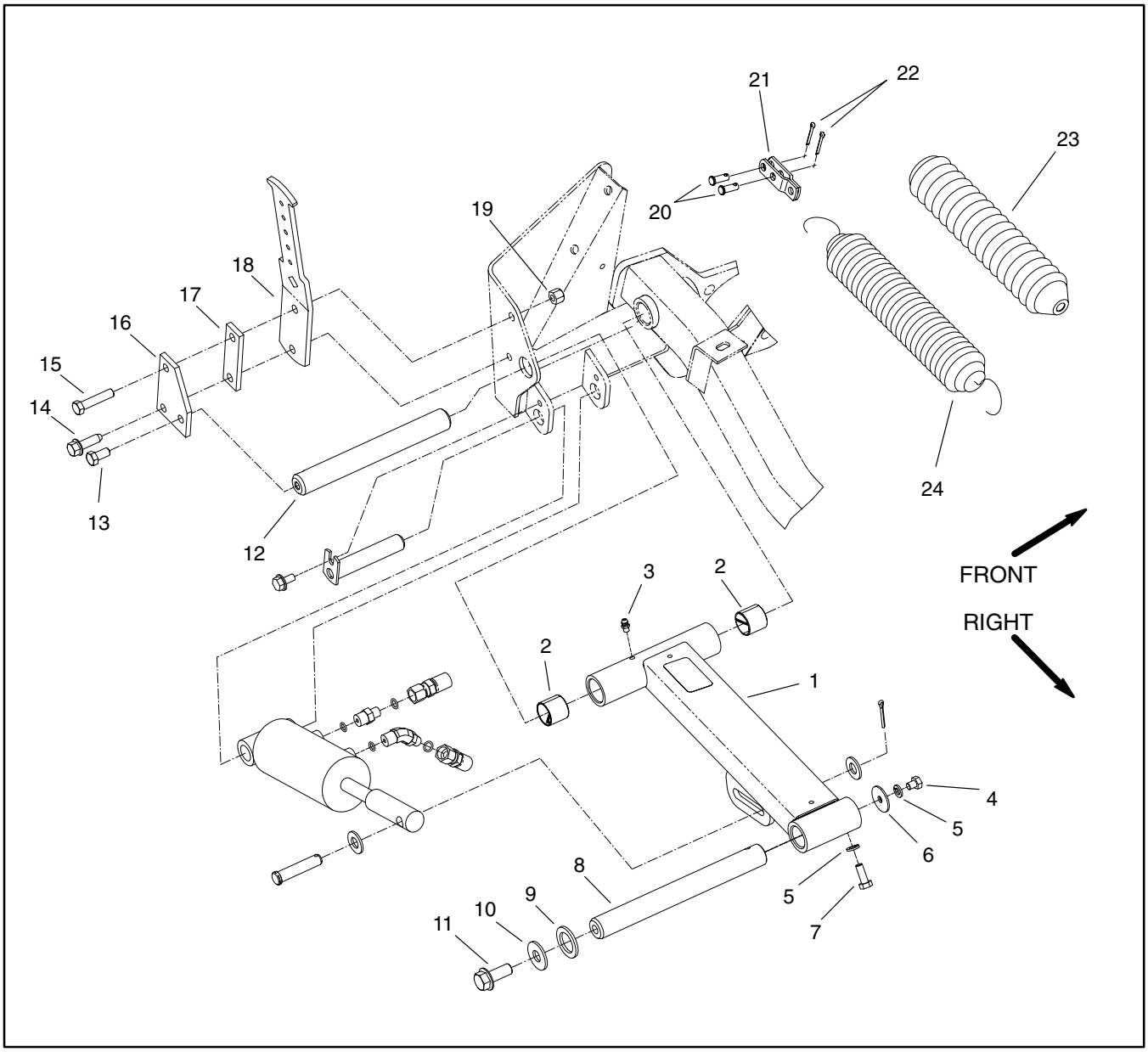

Figure 9

1. **Lift arm**
2. **Bushing**
3. **Grease fitting**
4. **Cap screw**
5. **Lock washer**
6. **Flat washer**
7. **Cap screw**
8. **Cutting unit pivot shaft**
9. **Thrust washer**
10. **Flat washer**
11. **Flange head screw**
12. **Lift arm pivot shaft**
13. **Cap screw**
14. **Self tapping screw**
15. **Cap screw**
16. **Reinforcement plate**
17. **Spacer**
18. **Spring tension arm**
19. **Lock nut**
20. **Clevis pin**
21. **Shackle**
22. **Cotter pin**
23. **Sleeve**
24. **Spring**

Disassembly

1. Remove cutting unit from lift arm (see Traction Unit Operator's Manual).

2. Remove rear lift arm components from machine using Figure 9 as a guide.

Assembly

1. Install rear lift arm components to machine using Figure 9 as a guide. Mount cutting unit to lift arm (see Traction Unit Operator's Manual).

2. See Traction Unit Operator's Manual for adjustment procedures.

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Chapter 7

Cutting Units

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Specifications

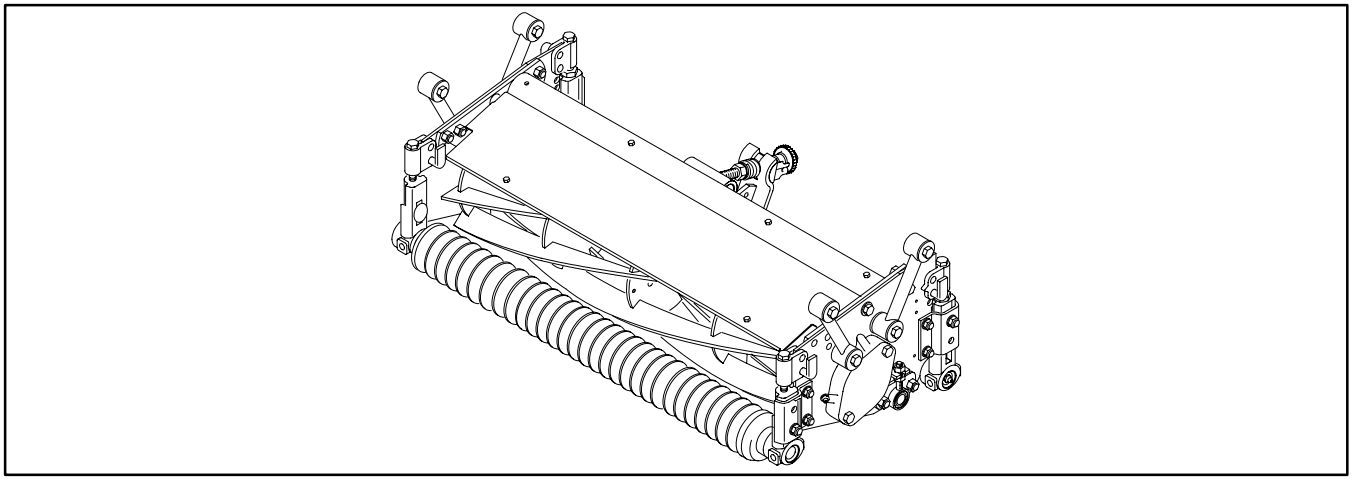

Figure 1

MOUNTING: All cutting units are supported by equal length, independent lift arms and are interchangeable to all three cutting unit positions.

CONSTRUCTION: 5, 8, or 11 blades of 7 inches (18 cm) diameter welded to stamped steel spiders. Reels are mounted on greaseable self–aligning ball bearings. Cutting unit reel length of either 27 inches (69 cm) or 32 inches (81 cm).

HEIGHT OF CUT RANGE:
Floating Cutting Unit – 1/4 to 1–3/4 inches (6mm to 44mm).
Fixed Cutting Unit – 1/2 to 2–5/8 inches (13mm to 67mm).

POWER: Hydraulic reel motors allow easy removal from or installation onto the cutting unit. Cutting units can be driven from either end.

HEIGHT–OF–CUT & ROLLER ADJUSTMENT: Height–of–cut adjustment is made with the rollers by a quick locating pin and/or threaded micro–adjustment.

BEDKNIFE AND BEDBAR ADJUSTMENT: A single knob screw adjustment for bedknife to reel is located at the center of the bedbar.

CUTTING UNIT LIFT: Hydraulic lift has an automatic reel shut off. Lift for all cutting units are controlled from one lever.

SUSPENSION SYSTEM: A fully floating suspension with hydraulic counterbalance. L–I–N–K–S™ cutting unit suspension system provides fore and aft oscillation. Main center pivot allows side–to–side oscillation. With optional Fixed Kit (Part No. 93–6915), cutting units can be locked into fixed (fore/aft) position for use with skids or anti–scalp rollers.

CLIP FREQUENCY: With variable speed set to maximum reel RPM (1040 RPM):

Reel Blades	Ground Speed	Clip Frequency
5 (27” or 32”)	5 mph (8 km/h)	1.00” (25mm)
5 (27’ or 32”)	6 mph (9.7 km/h)	1.20” (30.5mm)
8 (27’ or 32”)	5 mph (8 km/h)	0.63” (16mm)
8 (27’ or 32”)	6 mph (9.7 km/h)	0.76” (19mm)
11 (27” only)	5 mph (8 km/h)	0.46” (12mm)
11 (27” only)	6 mph (9.7 km/h)	0.55” (14mm)

CUTTING UNIT WEIGHT:

Model 03210 (27” 5 blade)	136 lb (62 kg)
Model 03211 (27” 8 blade)	143 lb (65 kg)
Model 03214 (27” 11 blade)	149 lb (68 kg)
Model 03212 (32” 5 blade)	158 lb (72 kg)
Model 03213 (32” 8 blade)	167 lb (76 kg)

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Special Tools

Order Special Tools from your Toro Distributor. Some tools may have been supplied with your machine or are available as Toro parts.

Gauge Bar Assembly

Use gauge bar to verify height−of−cut and bedknife attitude.

Toro Part Number: **98-1852**

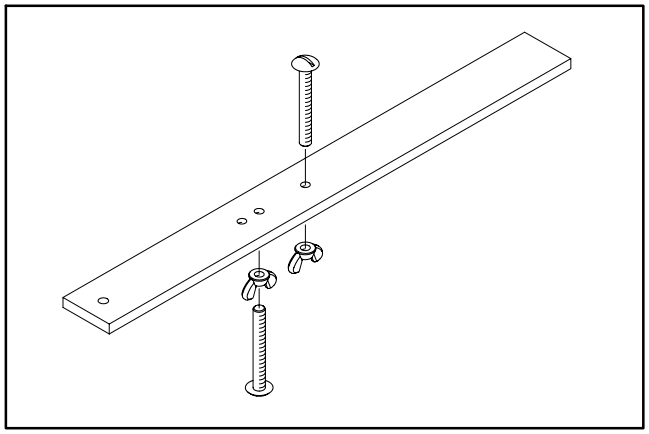

Figure 2

Handle Assembly

For applying lapping compound to cutting units while keeping hands a safe distance from the rotating reel.

Toro Part Number: **TOR299100**

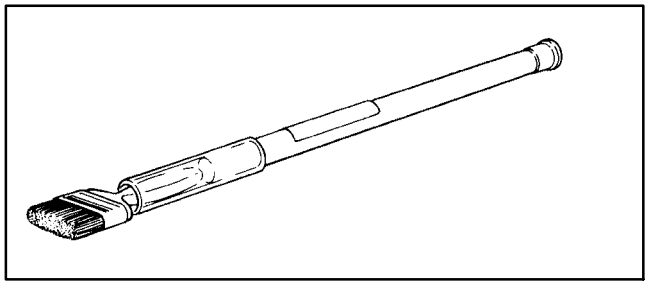

Figure 3

Bedknife Screw Tool

This screwdriver type bit is made to fit Toro bedknife attaching screws. Use this bit with a torque wrench to secure the bedknife to the bedbar.

IMPORTANT: Do not use an air or manual impact wrench with this tool.

Toro Part Number: **TOR510880**

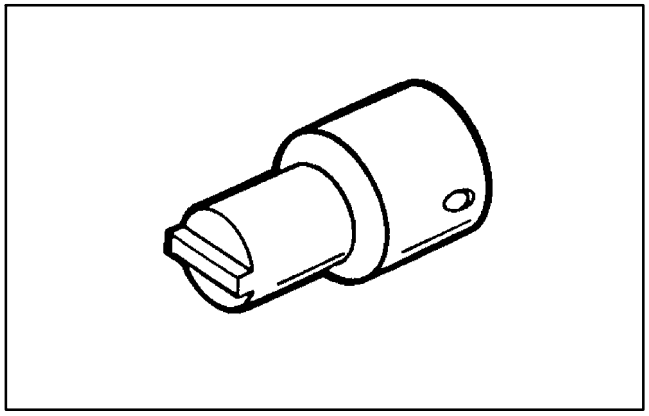

Figure 4

Angle Indicator

Use with Gauge Bar Assembly to verify bedknife attitude.

Toro Part Number: **99–3503**

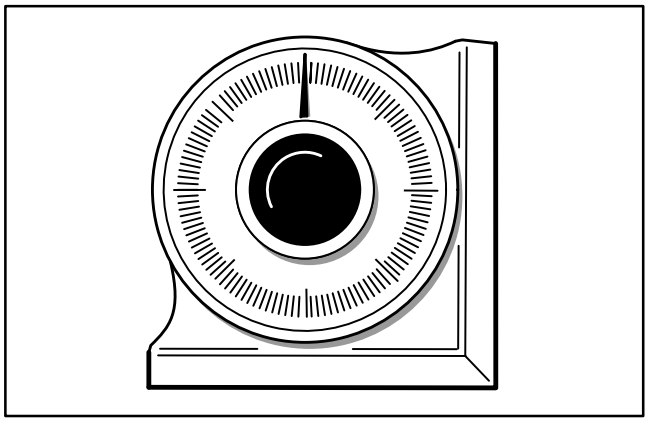

Figure 5

Turf Evaluator Tool

Many turf discrepancies are subtle and require closer examination. In these instances, the Turf Evaluator grass viewing tool is helpful. It can assist turf managers and service technicians in determining causes for poor reel mower performance and in comparing the effective height–of–cut of one mowed surface to another. This tool should be used with the Toro Guide to Evaluation Reel Mower Performance and Using the TurfEvaluator (Toro part no. 97931SL)

Toro Model Number: **04399**

Figure 6

Troubleshooting

There are a number of factors that can contribute to unsatisfactory quality of cut, some of which may be turf conditions. Turf conditions such as excessive thatch, “sponginess” or attempting to cut off too much grass height may not always be overcome by adjusting the machine. It is important to remember that the lower the height–of–cut, the more critical these factors are.

Remember that the “effective” or actual height–of–cut depends on cutting unit weight and turf conditions. Effective height–of–cut will be different than the bench set height–of–cut.

For additional information regarding cutting unit troubleshooting, see Aftercut Appearance Troubleshooting Aid (Toro part no. 00076SL).

Factors That Can Affect Quality Of Cut

Factor	Possible Problem/Correction
1. Engine maximum governed speed.	Check maximum governed engine speed. Adjust speed to specifications if necessary. If engine is not running at specified maximum governed RPM, reel speed settings may not match ground speed.
2. Reel speed and ground speed.	Adjust reel speed to setting shown on REEL SPEED SELECTION CHART for the number of reel blades (5 or 8) and the desired ground speed (see Traction Unit Operator’s Manual). All reels should rotate at the same speed. All cutting units should have equal bedknife to reel contact. If checking RPM, do not run reel too long without cutting grass, or bedknife and/or reel may overheat and “rifle”. See other items in Troubleshooting section of Chapter 4 – Hydraulic System.
3. Tire pressure.	Check each tire’s pressure. Adjust to pressures specified in Specifications section of Chapter 6 – Chassis.
4. Reel bearing condition.	All reels should rotate freely. Make sure bearings are properly lubricated. Replace bearings if worn or damaged.
5. Reel and bedknife sharpness.	Reel and/or bedknife that has rounded cutting edges or “rifling” **cannot** be corrected by tightening bedknife to reel contact. Grind reel to remove taper and/or rifling (grooved or wavy appearance). Grind bedknife to sharpen and/or remove rifling. (Most common cause of rifling is bedknife to reel contact that is **too tight**.) **NOTE:** New bedknife must be ground or backlapped after installing on bedbar.

Factor	Possible Problem/Correction
6. Bedknife to reel adjustment.	Check bedknife to reel contact daily. Bedknife must have light contact all across the reel. No contact will cause cutting edges to become dull. Excessive contact accelerates wear; quality of cut may be adversely affected. Slightly dull cutting edges may be corrected by backlapping. Excessively dull cutting edges must be corrected by grinding the reel and bedknife.
7. Front roller position.	Make sure front rollers on all cutting units are in the same position.
8. Rear roller parallel to reel.	Rear roller must be set so that it is parallel with the reel before setting height–of–cut.
9. Height–of–cut.	Make sure all cutting units are set at the same height–of–cut. Set units as specified in the Cutting Unit Operator's Manual.
10. Bedbar stability.	Check bedbar end bushings, adjuster pivot bushings, and nylon flanged bushings for wear or damage. Check bedbar adjustment knob to make sure detent holds adjustment.
11. Number of reel blades.	Use cutting unit model with the correct number of blades for clip frequency and optimum quality of cut range (see Specifications).
12. Cutting unit alignment and ground following.	Check lift arms and cutting unit pivot linkages for wear, damage, binding, or bent pivot pins.
13. Roller condition.	All rollers should rotate freely. Make sure roller bearings are properly lubricated. Replace bearings if worn or damaged.

Adjustments

CAUTION

Never install or work on the cutting units or lift arms with the engine running. Always stop engine and remove key first.

See Cutting Unit Operator's Manual for adjustment procedures for the cutting units on the Reelmaster 2000–D.

Characteristics

The single knob bedknife–to–reel adjustment system incorporated in this cutting unit simplifies the adjustment procedure needed to deliver optimum mowing performance. The precise adjustment possible with the single knob/bedbar design gives the necessary control to provide a continual self–sharpening action. This feature maintains sharp cutting edges, assures good quality of cut, and greatly reduces the need for routine backlapping.

In addition, the rear roller positioning system permits optimum bedknife attitude and location for varying height–of–cuts and turf conditions.

If a cutting unit is determined to be out of adjustment, complete the following procedures in the specified order to adjust the cutting unit properly.

1. Adjust the bedknife parallel to the reel.
2. Set height–of–cut and level the rear roller.
3. Verify height–of–cut and level the front roller.
4. Verify reel to bedknife clearance.

Refer to the Cutting Unit Operator's Manual for adjustment procedures.

Hydraulic Reel Motor

Removal (Fig. 7)

1. Remove two cap screws holding the hydraulic motor to the bearing housing.

2. Remove hydraulic motor, o–ring, and spider coupler from the bearing housing. Position hydraulic motor away from the cutting unit prior to removing or working on the cutting unit.

Inspection

1. Inspect spider coupler for wear. Replace spider coupler if worn.

2. Check reel coupler inside bearing housing. If reel coupler is loose, remove and check for worn threads. Replace coupler if threads are worn. Reinstall reel coupler (see Cutting Reel).

Installation (Fig. 7)

NOTE: The cutting unit can be installed with the hydraulic motor on either side. If installing on the opposite side, remove cap screws, cover, and cover gasket; reinstall them on the other bearing housing.

1. Dip spider coupler in No. 2 general purpose lithium base grease. Reinstall spider coupler into the bearing housing.

2. Install o–ring on the front plate of the motor. Mount hydraulic motor to the bearing housing. Secure motor with two cap screws.

3. Grease bearing housing sufficiently to fill housing with grease (see Cutting Unit Operator's Manual).

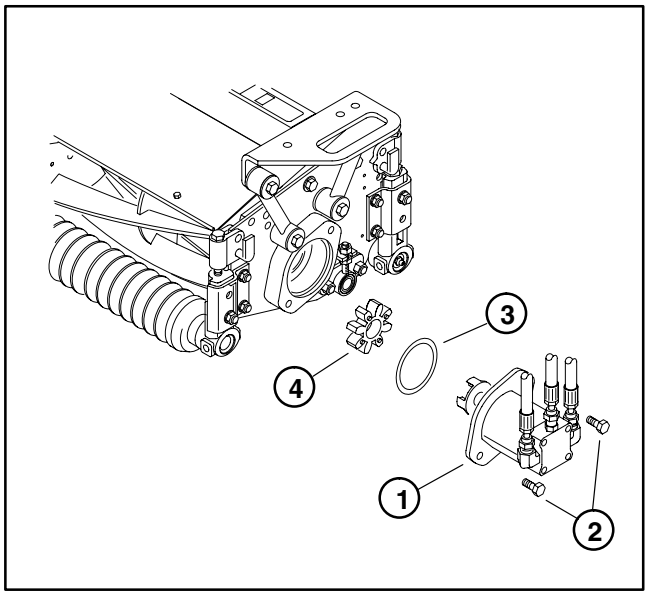

Figure 7

1. Reel motor
2. Cap screw
3. O–ring
4. Spider coupler

Bedbar

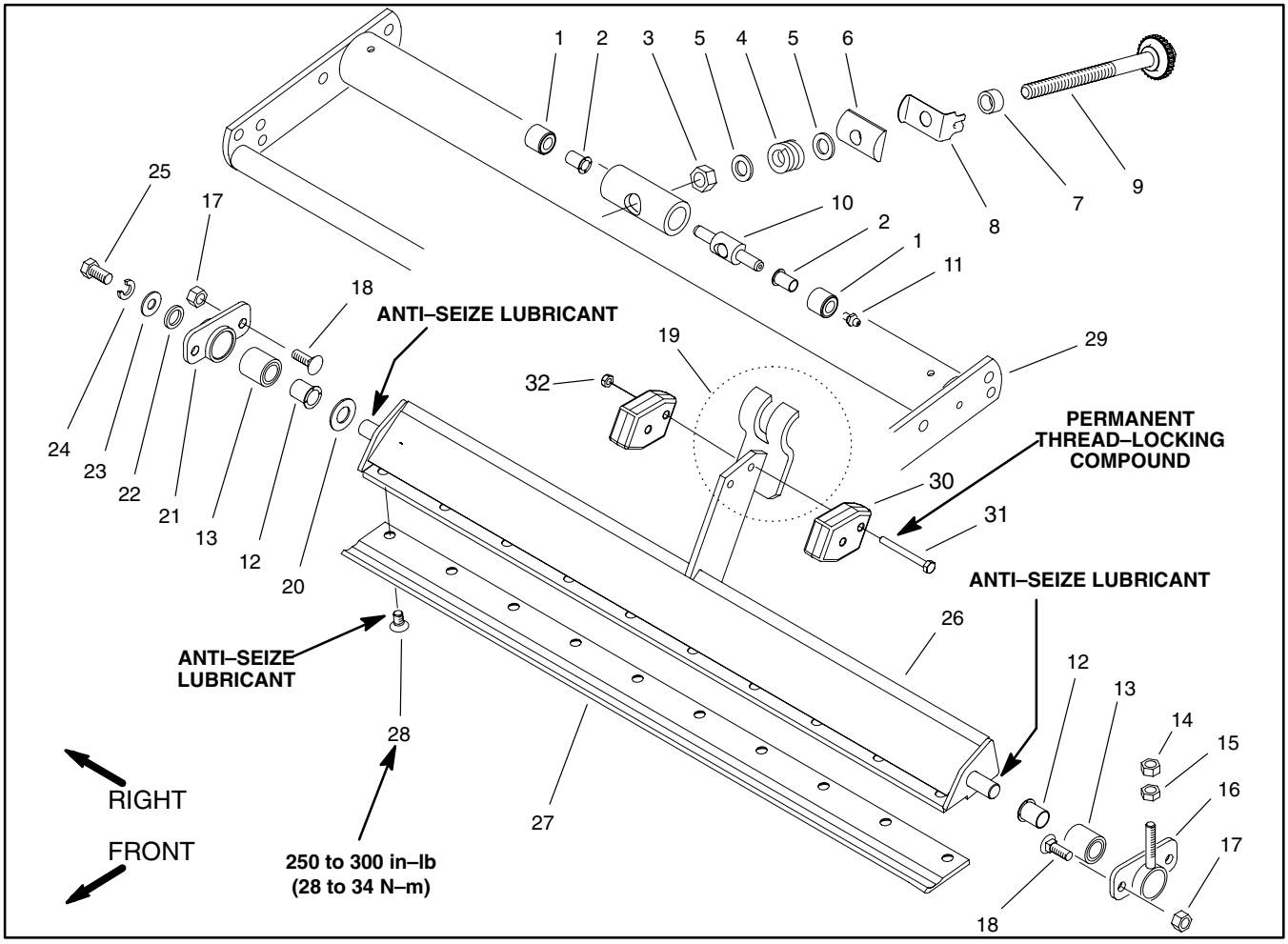

Figure 8

1. Rubber bushing
2. Flanged bushing
3. Jam nut
4. Compression spring
5. Washer
6. Bedbar fitting
7. Adjuster spacer
8. Spring arm
9. Bedbar adjuster
10. Bedbar pivot
11. Grease fitting
12. Flange bushing
13. Bushing
14. Adjusting lock nut
15. Adjusting nut
16. Adjusting housing
17. Lock nut
18. Carriage bolt
19. Bedbar yoke
20. Bedbar washer
21. Bedbar housing
22. Spacer
23. Flat washer
24. Lock washer
25. Cap screw
26. Bedbar
27. Bedknife
28. Bedknife screw
29. Reel frame
30. Weight (Models 03213 and 03214)
31. Cap screw
32. Lock nut

Removal

1. Turn bedbar adjuster to loosen bedknife to reel contact. Unscrew bedbar adjuster (left–hand threaded) while loosening jam nut from the compression spring until the bedbar fitting is clear of the bedbar yoke.

2. Remove capscrew, lock washer, flat washer, and spacer from the right end of the bedbar.

3. Loosen adjustment nuts on the adjusting housing (Fig. 9).

4. Remove both carriage bolts and nuts from the adjusting housing (Fig. 9).

5. Remove both carriage bolts and nuts from the bedbar housing. Remove bedbar from the cutting unit.

6. Remove adjusting housing and bedbar housing from the bed bar. Remove bedbar washer.

7. If necessary (Models 03213 and 03214), remove cap screws and lock nuts to allow removal of weights from bedbar. Cap screws have permanent thread–locking compound applied and may be difficult to remove.

8. Sharpen or replace bedknife as necessary (see Bedknife Replacement and Grinding).

Installation

1. Inspect flanged bushings and bushing for wear; replace if necessary.

2. Clean and apply anti–seize lubricant to both bedbar pivots. Install bedbar washer on the bedbar.

3. Install bedbar adjusting housing and bedbar housing on the bedbar. Reinstall spacer, flat washer, lock washer, and cap screw to the right end of the bedbar.

4. Position bedbar assembly to the cutting unit.

5. Secure bedbar housing to the cutting unit with both carriage bolts and nuts.

6. Secure adjusting housing to the cutting unit with both carriage bolts and nuts (Fig. 9).

7. Tighten both adjusting nuts on the adjusting housing (Fig. 9).

8. Position bedbar fitting to the bedbar yoke. Screw adjusting handle (left–hand threaded) until the bedbar fitting is snug against the bedbar yoke.

9. If weights were removed from bedbar (Models 03213 and 03214), apply permanent thread–locking compound to cap screw threads and secure weights to bedbar with cap screws and lock nuts.

10. Adjust bedknife to reel (see Cutting Unit Operator's Manual).

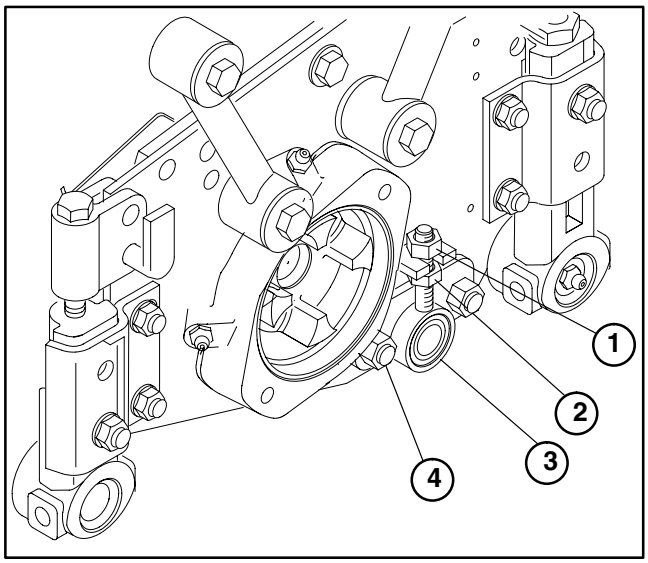

Figure 9

1. **Adjusting lock nut**
2. **Adjusting nut**
3. **Adjusting housing**
4. **Carriage bolt and nut**

Bedknife Replacement and Grinding

1. Remove bedbar from the cutting unit (see Bedbar Removal).

2. Remove bedknife screws and bedknife.

3. Remove all rust, scale and corrosion from the bedbar surface before installing new bedknife.

NOTE: Use a torque wrench and a bedknife screw tool to install bedknife screws.

4. Install new bedknife as follows:

   A. Make sure bedbar threads are clean.

   B. Use new bedknife screws. Apply anti–seize lubricant to the screw threads before installing.

IMPORTANT: Do not use an air or manual impact wrench to tighten bedknife screws.

   C. Tighten screws to a torque of 250 to 300 in–lb (28 to 34 N–m). Tighten screws from the **center** toward each end of the bedbar (Fig. 10).

5. Since there can be variations in the mounting surface of the bedbar, a new bedknife will not be perfectly flat after it is installed. It is therefore necessary to backlap or grind a new bedknife after installing it to the bedbar. Follow the existing angle that was ground into the bedknife and grind only enough to make sure the top surface is true.

6. Install bedbar to the cutting unit (see Bedbar Installation).

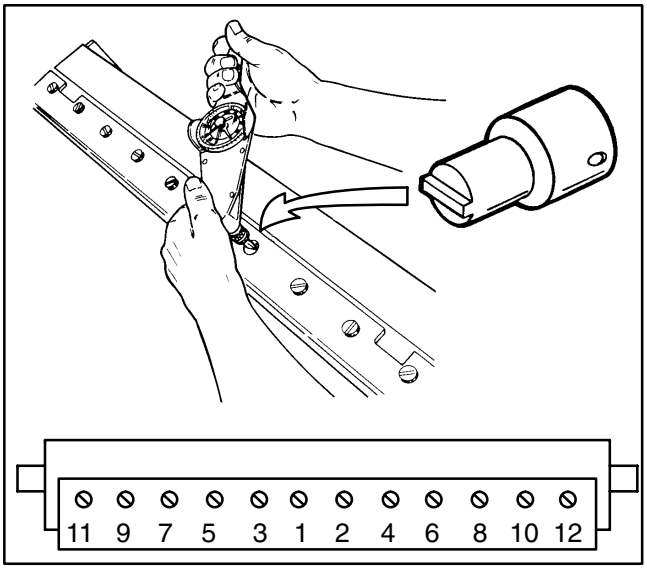

Figure 10

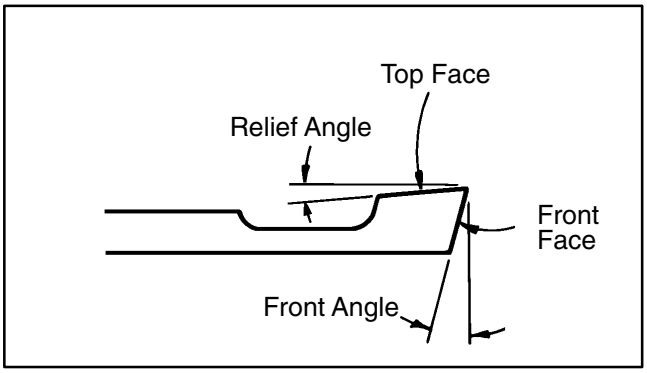

Figure 11

Regrinding Bedknife

Remove bedbar assembly from cutting unit before attempting to regrind a used bedknife (see Bedbar Removal).

NOTE: When grinding, be careful to not overheat the bedknife. Remove small amounts of material with each pass of the grinder.

NOTE: If the height of cut is 1/2 inch (13mm) or lower on the cutting unit, the front angle can be increased to 30º for improved performance.

Bedknife Regrinding Specifications	
Relief Angle	5º
Relief Angle Range	3º to 6º
Front Angle	15º (see NOTE above)
Front Angle Range	13º to 17º

Front and Rear Rollers

NOTE: This section can be used for both the front and rear rollers.

Roller Removal

1. Remove both height–of–cut pins and hairpin cotters from each roller bracket.

2. Remove both locknuts from the cap screws securing each angle bracket to the cutting unit.

3. Remove cap screws from both angle brackets and the cutting unit.

4. Separate roller assembly, height–of–cut brackets, and angle brackets from the cutting unit.

5. Remove height–of–cut brackets from the roller assembly.

Roller Installation

1. Inspect bushings in height–of–cut bracket for wear; replace if necessary.

NOTE: The flanged end of the flanged bushing must face inside toward the roller when the height–of–cut bracket is installed onto the cutting unit.

NOTE: A soft hammer may be needed to tap the height–of–cut bracket into position on the hex adjustment nut of the roller.

2. Insert smaller diameter roller shaft into the height–of–cut bracket with flanged bushing and bushing. Insert the other end of the roller shaft into the other height–of–cut bracket with bushing. **Make sure that hex of the height–of–cut brackets mate with the hex adjustment nut on the roller.**

3. Hold one height–of–cut bracket stationary and use the other bracket as a wrench to loosen or tighten bearing clearance. The roller must not exceed 5 in–lb (0.57 N–m) rolling torque and have no bearing end play.

4. Make sure height–of–cut brackets are aligned prior to installing them onto the cutting unit. If necessary after bearing adjustment, align height–of–cut brackets as follows:

   A. Remove height–of–cut bracket on the side with the flanged bushing.

   B. Adjust height–of–cut bracket so it is aligned to within ± one hex flat of the roller adjustment nut.

   C. Align both height–of–cut brackets.

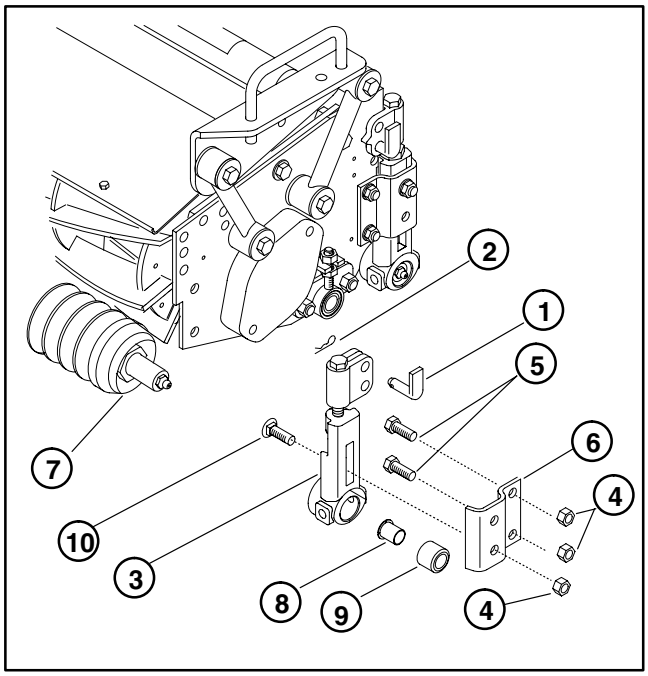

Figure 12

1. Height–of–cut pin
2. Hairpin cotter
3. Height–of–cut bracket
4. Lock nut
5. Cap screw
6. Angle bracket
7. Front roller assembly
8. Flanged bushing
9. Bushing
10. Carriage bolt

5. Mount roller, height–of–cut brackets, and angle brackets to the cutting unit. Secure height–of–cut brackets and angle brackets to the cutting unit with cap screws.

6. Install both height–of–cut pins and hairpin cotters.

7. Install locknuts to the cap screws and secure each angle bracket to the cutting unit.

8. Adjust roller level (see Cutting Unit Operator's Manual).

Roller Service

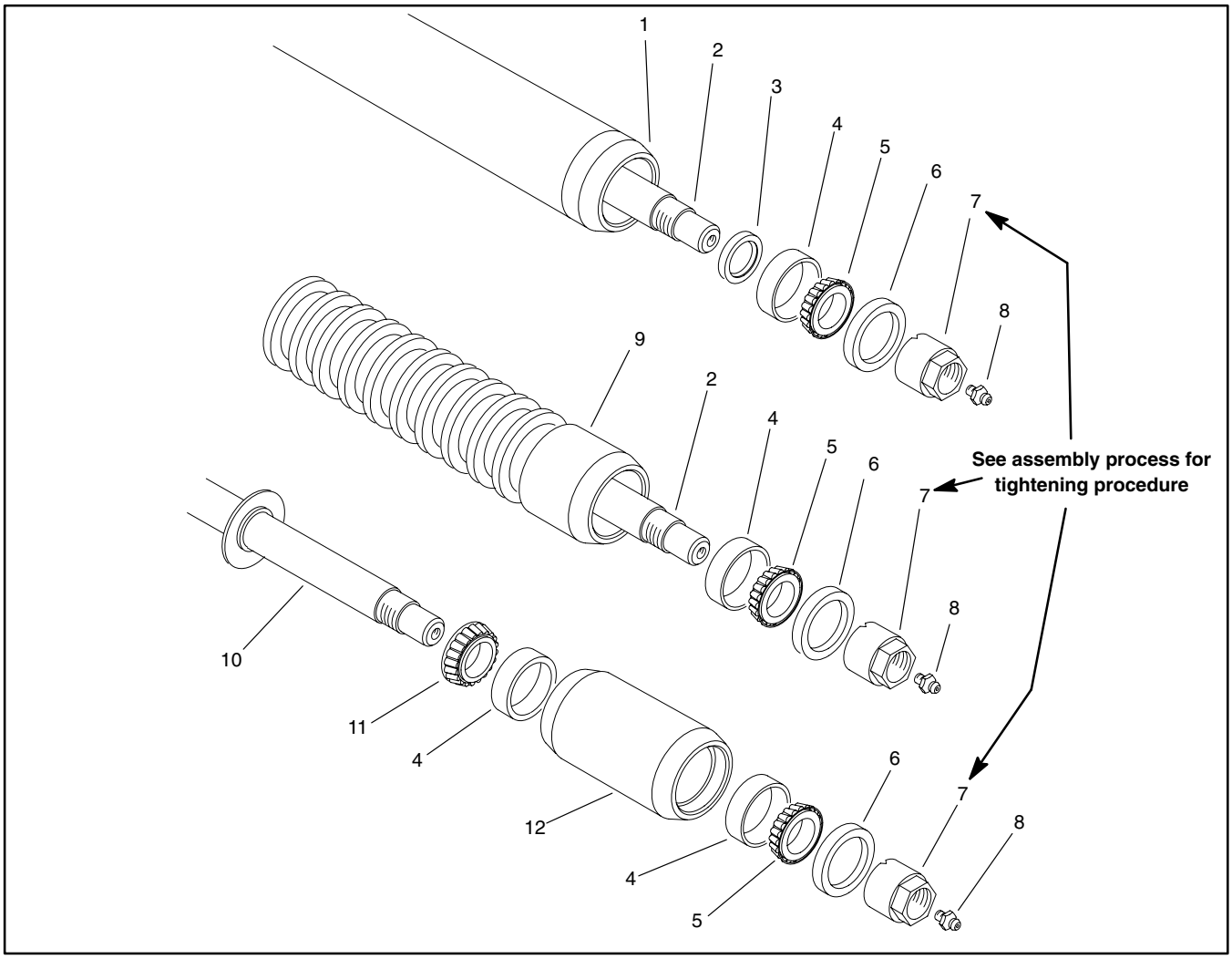

Figure 13

1. **Full roller**
2. **Roller shaft**
3. **Grease seal**
4. **Bearing cup**
5. **Bearing cone (outer)**
6. **Outer seal**
7. **Adjustment nut**
8. **Grease fitting**
9. **Wiehle roller**
10. **Sectional roller shaft**
11. **Bearing cone (inner)**
12. **Sectional roller**

Disassembly

1. Clean inside of roller around both adjustment nuts and roller shaft ends. Both areas should be free of dirt and debris.

2. Remove adjustment nut from one end of the roller shaft. On the sectional roller, remove adjustment nuts from each end of the roller.

3. Keep roller level and slide the shaft with the remaining adjustment nut out of the roller. On the sectional roller, slide both sectional rollers off the shaft.

4. Secure roller in a vise.

5. Remove outer seals.

6. Remove both bearing cones. On the sectional roller, remove all four bearing cones.

NOTE: An electric arc welder can be used to shrink the bearing cup to simplify its removal. Only a small arc in one location on the cup is required.

7. Remove both bearing cups from the roller. On the full roller, remove both inner seals. On the sectional roller, remove all four bearing cups.

8. Discard seals and bearings that were removed from roller.

Full or Wiehle Roller Assembly

1. Make sure all parts are clean prior to installing bearings and seals.

2. On a full roller, grease inner seal lips and install inner seal into each end of the roller. Make sure that cupped side of the seal faces the inside of the roller.

3. Make sure narrow end of the taper on the bearing cup faces the inside of the roller. Press a cup into each end of the roller.

4. Secure roller in a vise in a level position.

5. Pack both bearing cones with No. 2 general purpose lithium base grease.

6. Install a bearing cone into the bearing cup at each end of the roller.

7. Position outer seal to the roller with the hard surface of seal facing out. Grease seal lips and press a seal into each end of the roller.

8. Slide roller shaft (with adjustment nut installed on one end) through the bearing cones, seals, and roller.

9. Install remaining adjustment nut onto shaft and tighten it to seat both bearings. Roller should be rotated to seat bearings.

10. Back off both adjustment nuts to allow the roller to spin freely. Tighten both adjustment nuts again so there is no bearing end play and rolling torque does not exceed 5 in–lb (0.57 N–m).

11. Grease bearings (see Cutting Unit Operator's Manual).

Sectional Roller Assembly

1. Make sure all parts are clean prior to installing bearings and seals.

2. Press two bearing cups into each sectional roller. Make sure narrow end of taper faces the inside of the roller.

3. Secure sectional roller shaft in a vise. Make sure shaft is level.

4. Pack all bearing cones with No. 2 general purpose lithium base grease.

NOTE: Install the bearing cone with the seal into the end of the roller that faces the inner part of the shaft.

5. On both rollers, install a bearing cone into the bearing cup at each end of the roller.

6. Grease outer seal lips and install seal into the end of each roller. Make sure the hard surface of seal faces out.

7. Slide each roller onto the shaft.

8. Install adjustment nut onto each end of the shaft. Tighten each nut to seat both bearings of each roller. Roller should be rotated to seat both bearings.

9. Back off both adjustment nuts to allow the rollers to spin freely. Tighten both adjustment nuts again so there is no bearing end play and rolling torque does not exceed 5 in–lb (0.57 N–m).

10. Grease bearings (see Cutting Unit Operator's Manual).

Cutting Reel

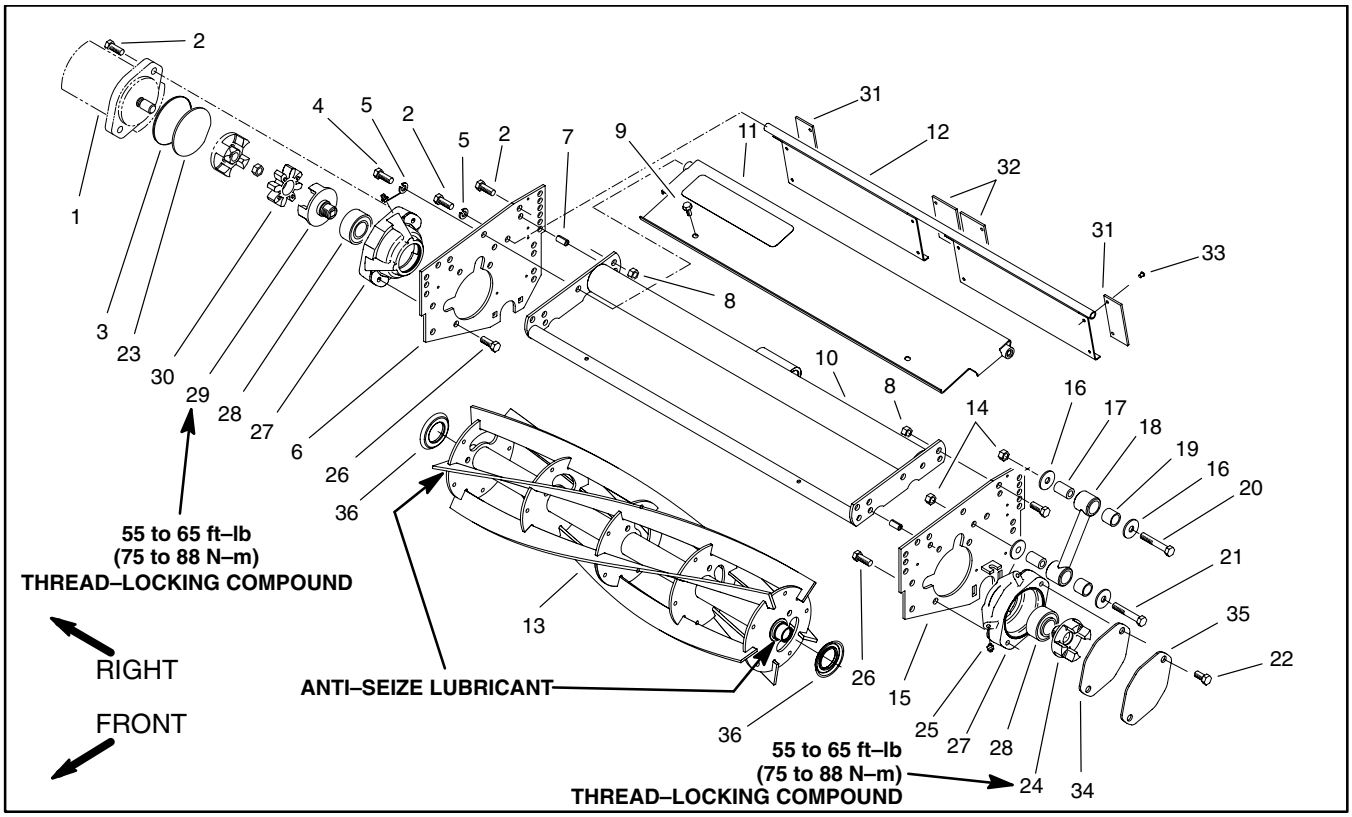

Figure 14

1. Hydraulic motor
2. Cap screw
3. O–ring
4. Cap screw
5. Lock washer
6. Side plate (RH)
7. Roll pin
8. Lock nut
9. Washer head screw
10. Frame assembly
11. Front grass guard
12. Rear grass guard
13. Cutting reel
14. Flange nut
15. Side plate (LH)
16. Washer
17. Spacer
18. Link
19. Bushing
20. Cap screw
21. Cap screw
22. Cap screw
23. Shipping plug
24. Reel coupler (LH)
25. Grease fitting
26. Flange head screw
27. Bearing housing
28. Bearing
29. Reel coupler (RH)
30. Spider coupler
31. Rubber side cover
32. Rubber center cover
33. Rivet
34. Cover gasket
35. Cover
36. Seal guard (8 & 11 blade reels)

Remove Cutting Reel (Fig. 14)

1. Remove hydraulic motor from the cutting unit (see Hydraulic Reel Motor Removal). Remove cover and gasket from the opposite end of the cutting unit.

2. Remove cutting unit from the machine (see Traction Unit Operator's Manual).

3. Remove bedbar assembly from the cutting unit (see Bedbar Removal).

4. Remove front roller from the cutting unit (see Roller Removal).

NOTE: A 3/8–inch drive ratchet with an extension will fit into the square hole of the reel coupler.

5. Unscrew reel coupler (LH) from the reel. **This coupler has left hand threads.** Unscrew reel coupler (RH) from the reel. **This coupler has right hand threads.**

IMPORTANT: Support reel to prevent it from dropping when the bearing housings are removed.

6. Remove flange head screws from both bearing housings. Pull bearing housings and bearings from reel. Remove reel from the cutting unit.

7. Rotate bearings within the bearing housings and remove bearings from both bearing housings through the loading grooves.

Inspect Cutting Reel (Fig. 14)

1. Replace reel if the diameter has decreased to the service limit (see Reel Grinding Specification in Preparing Reel For Grinding).

2. Replace reel if blades are bent or cracked.

3. Check for a bent reel shaft by placing the reel shaft ends in V–blocks. Replace reel if the reel shaft is bent.

Install Cutting Reel (Fig. 14)

1. Inspect reel bearings and replace if worn or damaged. Replace both bearings as a set.

2. Make sure bearing seating surfaces and threads on reel shaft ends are clean. Apply anti–seize lubricant to both bearing seating surfaces of reel shaft.

3. Position reel inside the cutting unit and align with the bearing housing holes. The reel must be positioned so that the grooved end of the shaft (left–hand threads) is on the left side of the cutting unit.

4. Clean inside of the bearing housings. Install bearings into bearing housing as follows:

   A. Load bearing through loading grooves.

   B. Position bearing so its outer grease holes will be 90º to the loading grooves.

   C. Rotate bearing inside the housing so the extended part of the inner race is facing the inside of the housing.

5. Slide bearings and bearing housings onto the reel shaft.

6. Make sure bearing housings are installed with the grease fittings pointing up and to the front of the cutting unit.

7. Secure bearing housings to the cutting unit with flange head screws.

8. Remove any grease from the threaded end of the reel couplers and the reel shaft. Make sure grease is completely removed.

9. Apply medium strength thread–locking compound to reel coupler threads. **Do not get thread–locking compound on the bearing seal**.

10. Screw reel coupler (RH) to the reel. **This coupler has right hand threads.** Screw reel coupler (LH) to the reel. **This coupler has left hand threads.** Torque both couplers from 55 to 65 Ft–lb (75 to 88 N–m).

11. Install front roller to cutting unit (see Roller Installation).

12. Install bedbar assembly to cutting unit (see Bedbar Installation).

13. Complete cutting unit set–up and adjustment sequence (see Cutting Unit Operator's Manual).

14. Install cutting unit to machine (see Traction Unit Operator's Manual).

15. Install hydraulic motor to drive end of the cutting unit (see Hydraulic Reel Motor Installation). Install cover gasket, cover, and cap screws to the other end of the cutting unit.

16. Grease cutting unit (see Cutting Unit Operator's Manual).

Prepare Reel for Grinding

NOTE: Check to make sure reel bearings are in good condition and properly adjusted before grinding reel.

1. Remove bedbar assembly (see Bedbar Removal and Installation).

2. Remove front roller and brackets (see Roller Removal and Installation).

NOTE: Most reel grinders require that the rear roller assembly be mounted to the cutting unit for proper support in the reel grinder. The rear roller must be parallel to the reel shaft to remove taper when grinding, or the cutting unit must be aligned so the grinding wheel will travel parallel to the reel shaft. This will result in the the reel being ground to the desired cylinder shape.

NOTE: When grinding, be careful to not overheat the reel blades. Remove small amounts of material with each pass of the grinder.

3. After completing grinding process:

   A. Install front roller and brackets (see Roller Removal and Installation).

   B. Install bedbar assembly (see Bedbar Removal and Installation).

   C. Complete cutting unit set–up and adjustment sequence (see Cutting Unit Operator's Manual).

Reel Grinding Specifications	
Nominal Reel Diameter	7 inches (178 mm)
Service Limit Reel Diameter	6.2 inches (158 mm)
Blade Relief Angle	30°
Relief Angle Range	20° to 40°
Blade Land Width	0.060 inch (1.5 mm)
Land Width Range	0.050 to 0.090 inch (1.3 to 2.3 mm)
Maximum Reel Taper	0.060 inch (1.5 mm)

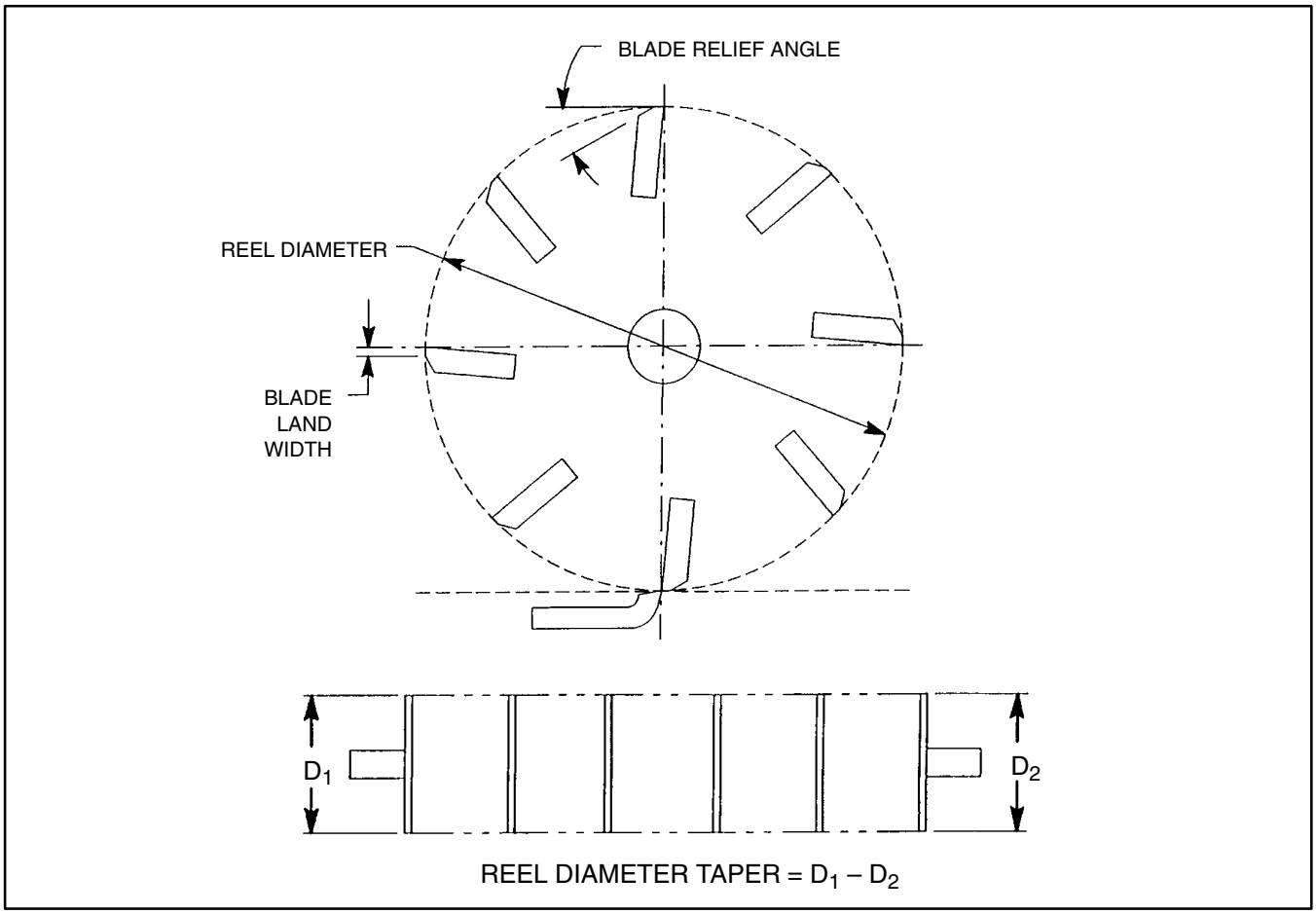

Figure 15

Fixed Side Plate Installation

1. Remove pop rivets and rear height–of–cut plates from both sides of the cutting unit (Fig. 16).

2. Remove lock nuts, cap screws, washers, and both links from the cutting unit (Fig. 16).

3. Align fixed side plate with holes on the cutting unit (Fig. 17).

4. Attach fixed side plate to the cutting unit with cap screws, washers, and flanged lock nuts (Fig. 17).

5. Tighten lock nuts and cap screws.

6. Fasten new height–of–cut plate to the cutting unit with pop rivets (Fig. 17).

7. Repeat steps 1 through 6 on the other side of the cutting unit.

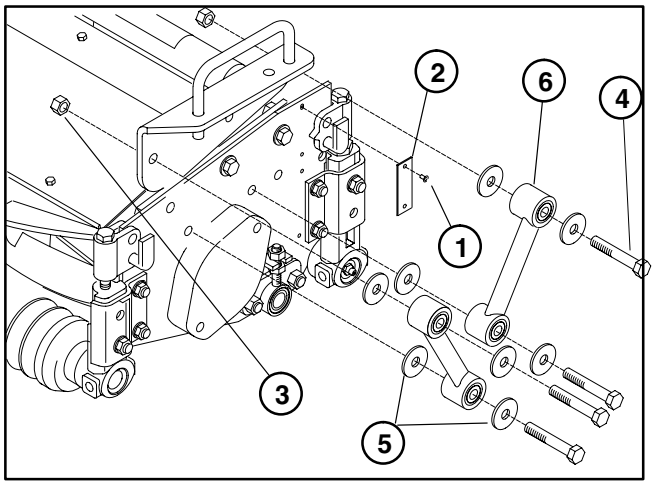

Figure 16

1. **Pop rivet**
2. **Height–of–cut plate**
3. **Lock nut**
4. **Cap screw**
5. **Washer**
6. **Link**

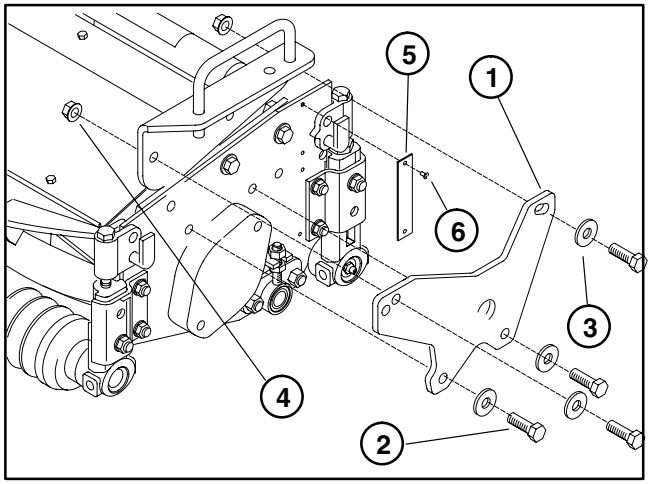

Figure 17

1. **Fixed side plate**
2. **Cap screw**
3. **Washers**
4. **Flanged lock nut**
5. **Height–of–cut plate**
6. **Pop rivet**

Skid Kit Installation

1. Remove front roller from the cutting unit (see Roller Removal).

2. Align skid slots with the angle bracket holes on the cutting unit.

3. Secure skid to the cutting unit with both flange head screws, flat washers, and lock nuts.

4. Repeat steps 1 through 3 on the other side of the cutting unit.

5. Adjust skid height as necessary by loosening lock nuts and flange head screws. After skid height adjustment, retighten fasteners.

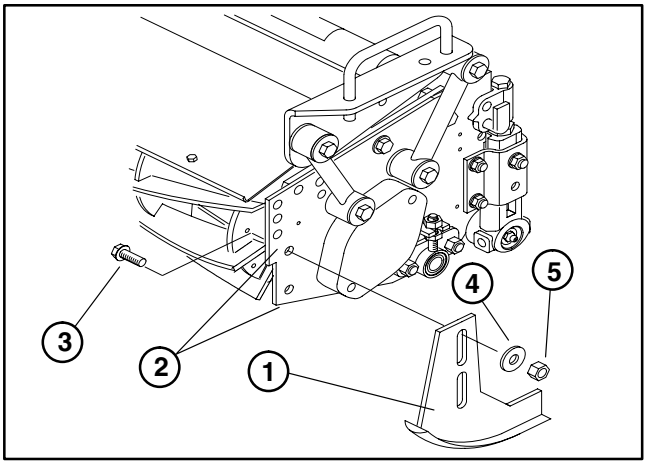

Figure 18

1. **Skid**
2. **Angle bracket holes**
3. **Flange head screw**
4. **Flat washer**
5. **Lock nut**

Chapter 8

Electrical Diagrams

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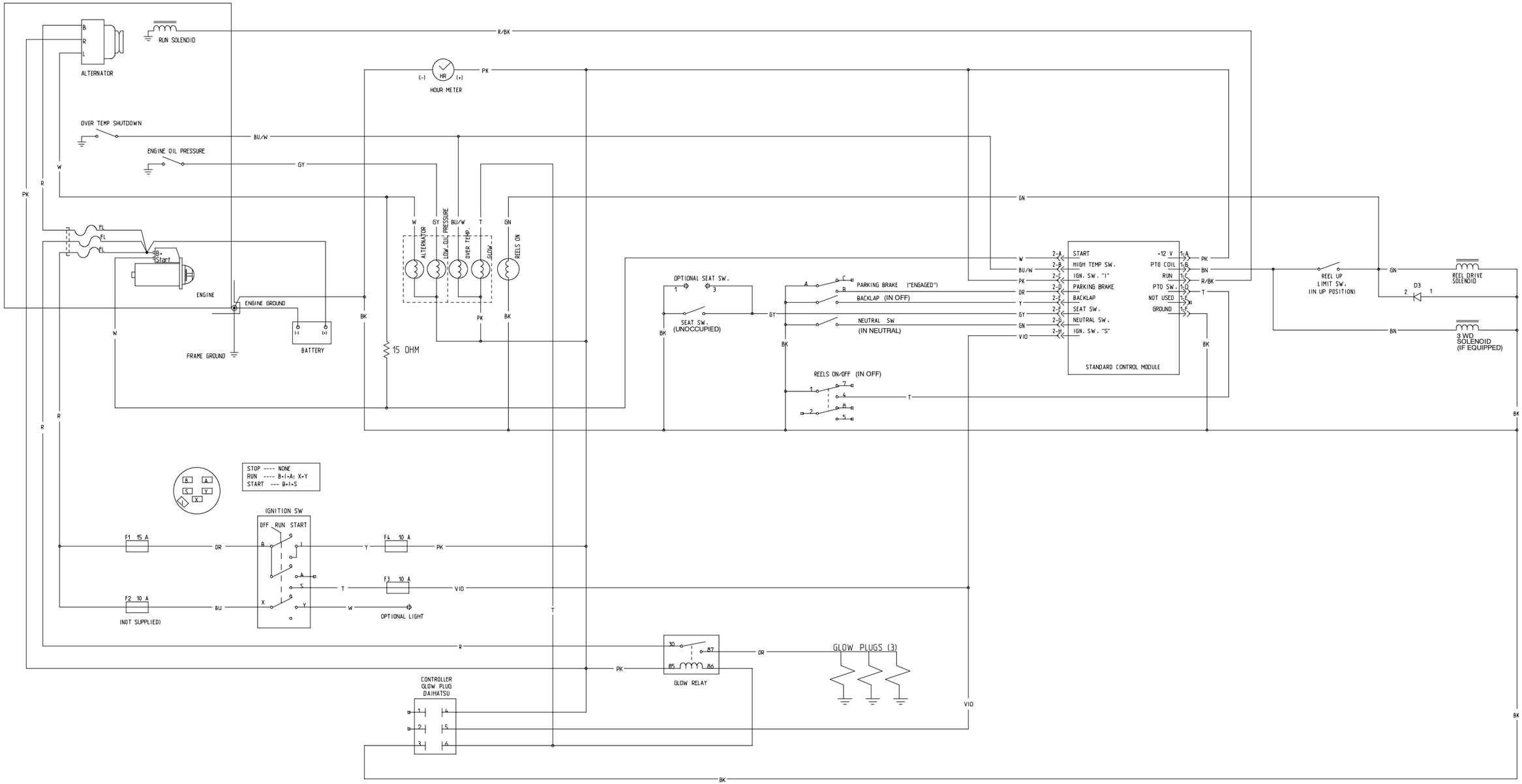


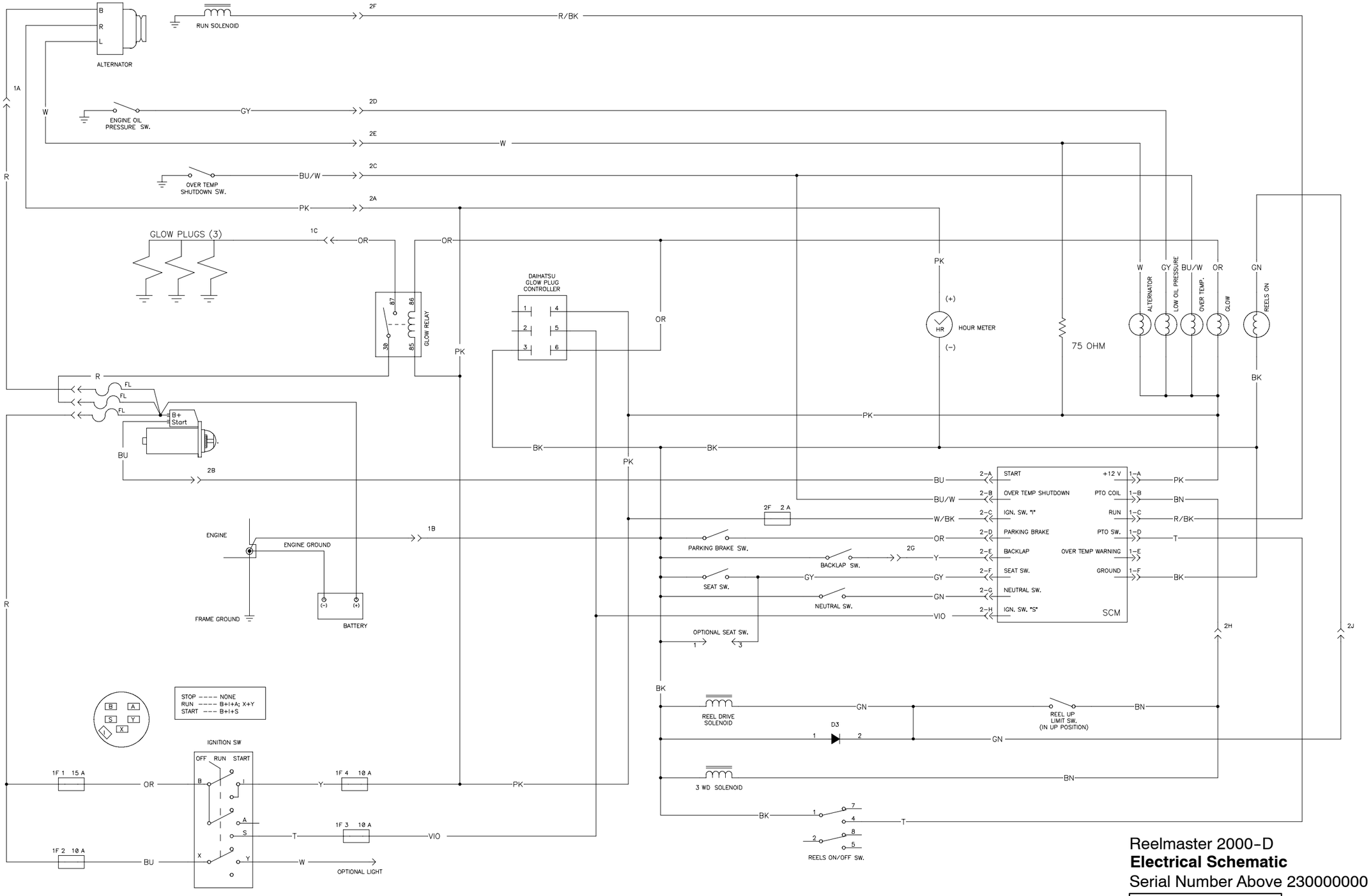
Reelmaster 2000-D

Electrical Schematic

Serial Number Below 230000000

All relays and solenoids are shown as de-energized.

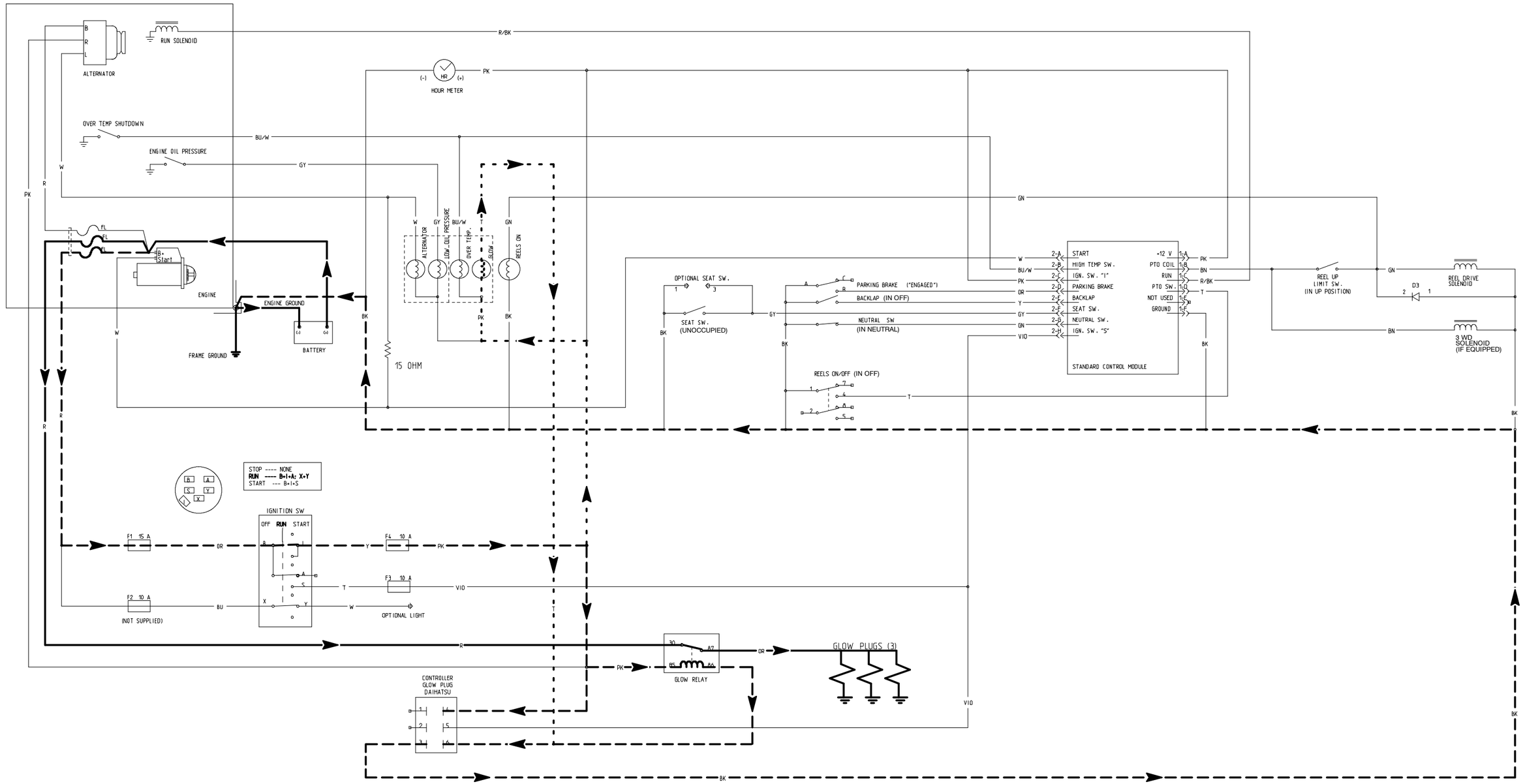
All ground wires are black.



Reelmaster 2000-D
Electrical Schematic
Serial Number Above 230000000

All relays and solenoids are shown as de-energized.

All ground wires are black.



Reelmaster 2000-D

Glow Plug Circuit

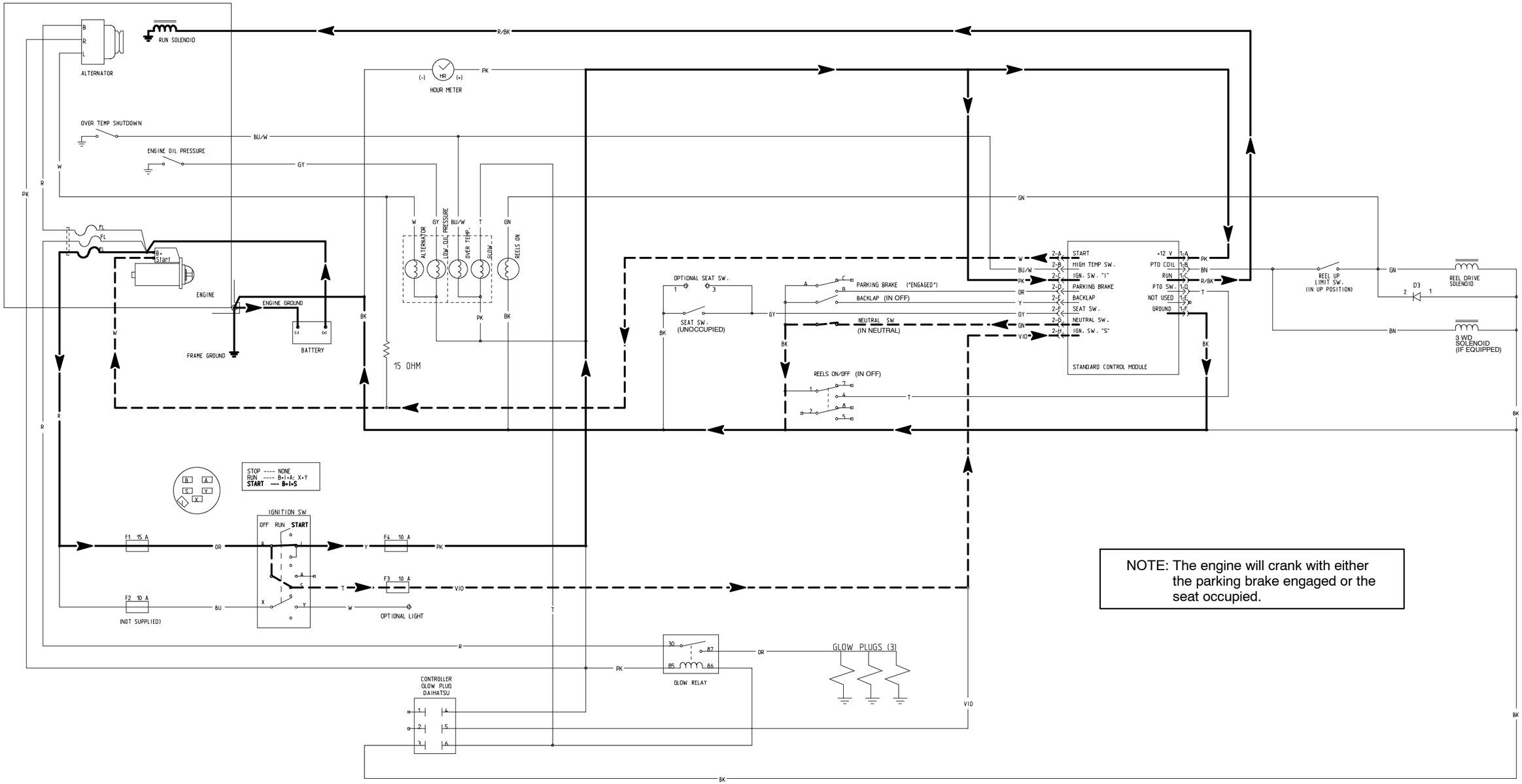
(Serial Number Below 230000000 Shown)

Power Current

Control Current

Indicator/Gauge Current

Logic Direction



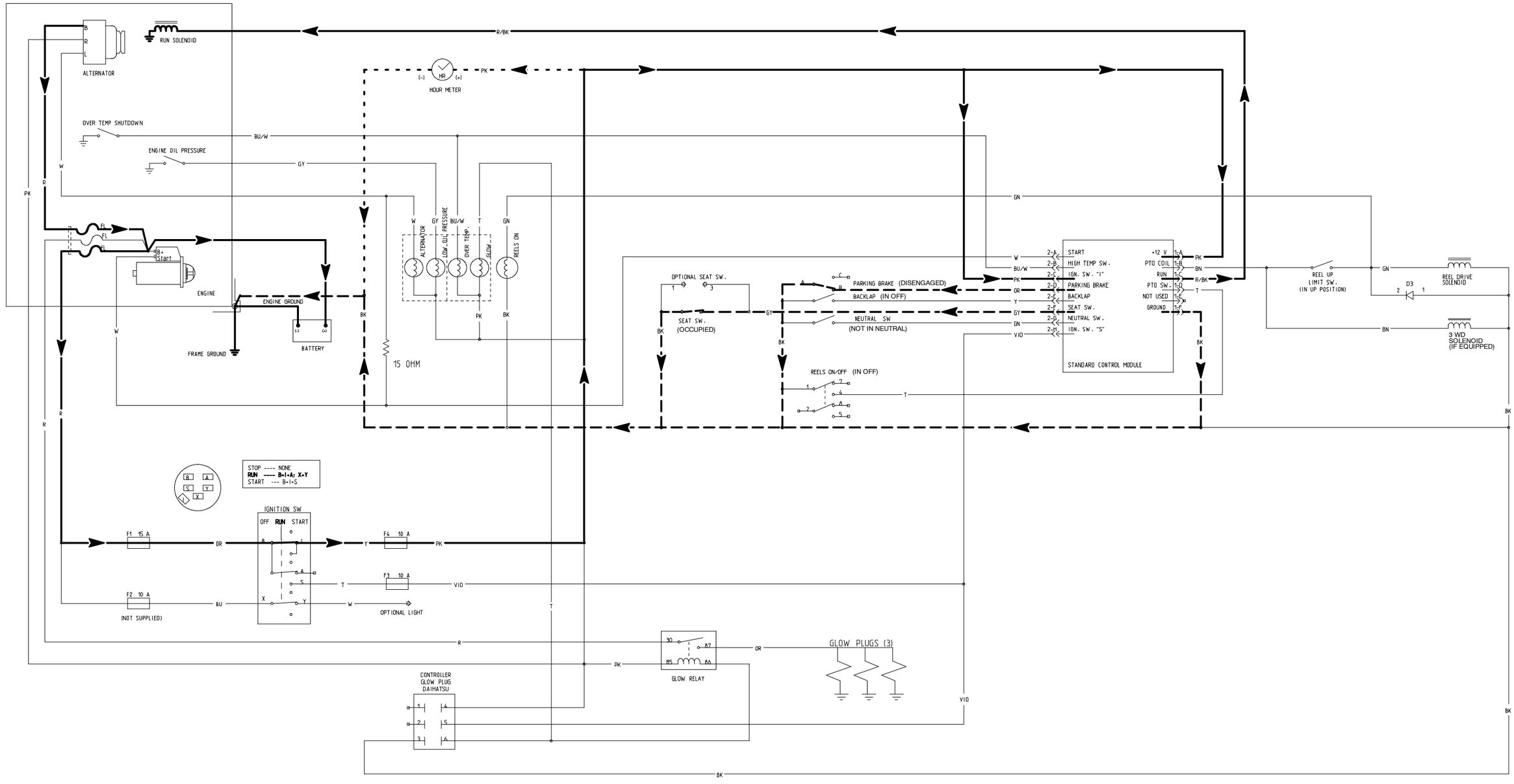
NOTE: The engine will crank with either the parking brake engaged or the seat occupied.

Reelmaster 2000-D

Crank Circuit

(Serial Number Below 230000000 Shown)

- Power Current
- Control Current
- Indicator/Gauge Current
- Logic Direction



Reelmaster 2000-D

Run (Transport) Circuit

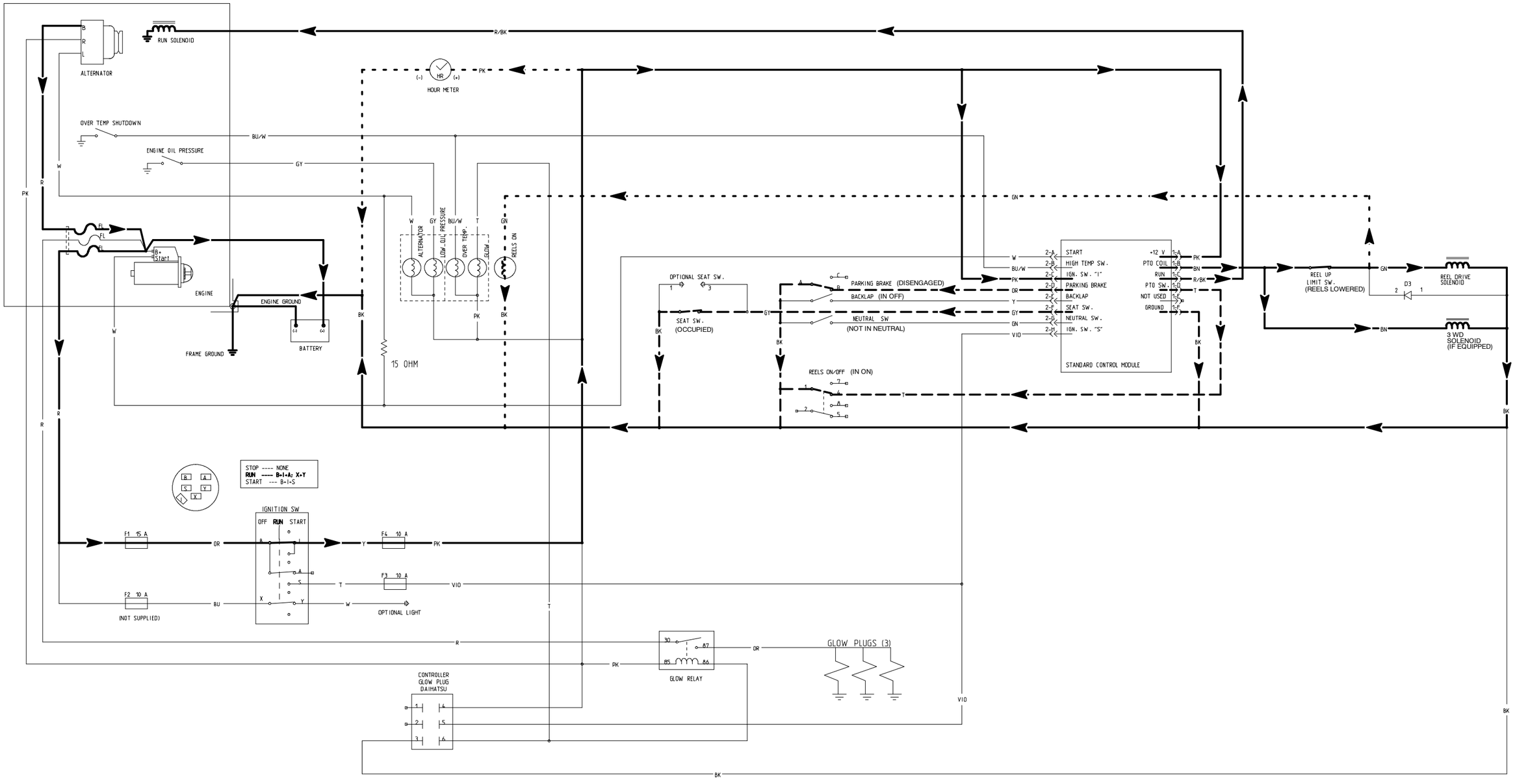
(Serial Number Below 230000000 Shown)

Power Current

Control Current

Indicator/Gauge Current

Logic Direction



Reelmaster 2000-D

Run (Mow) Circuit

(Serial Number Below 230000000 Shown)

Power Current

Control Current

Indicator/Gauge Current

Logic Direction

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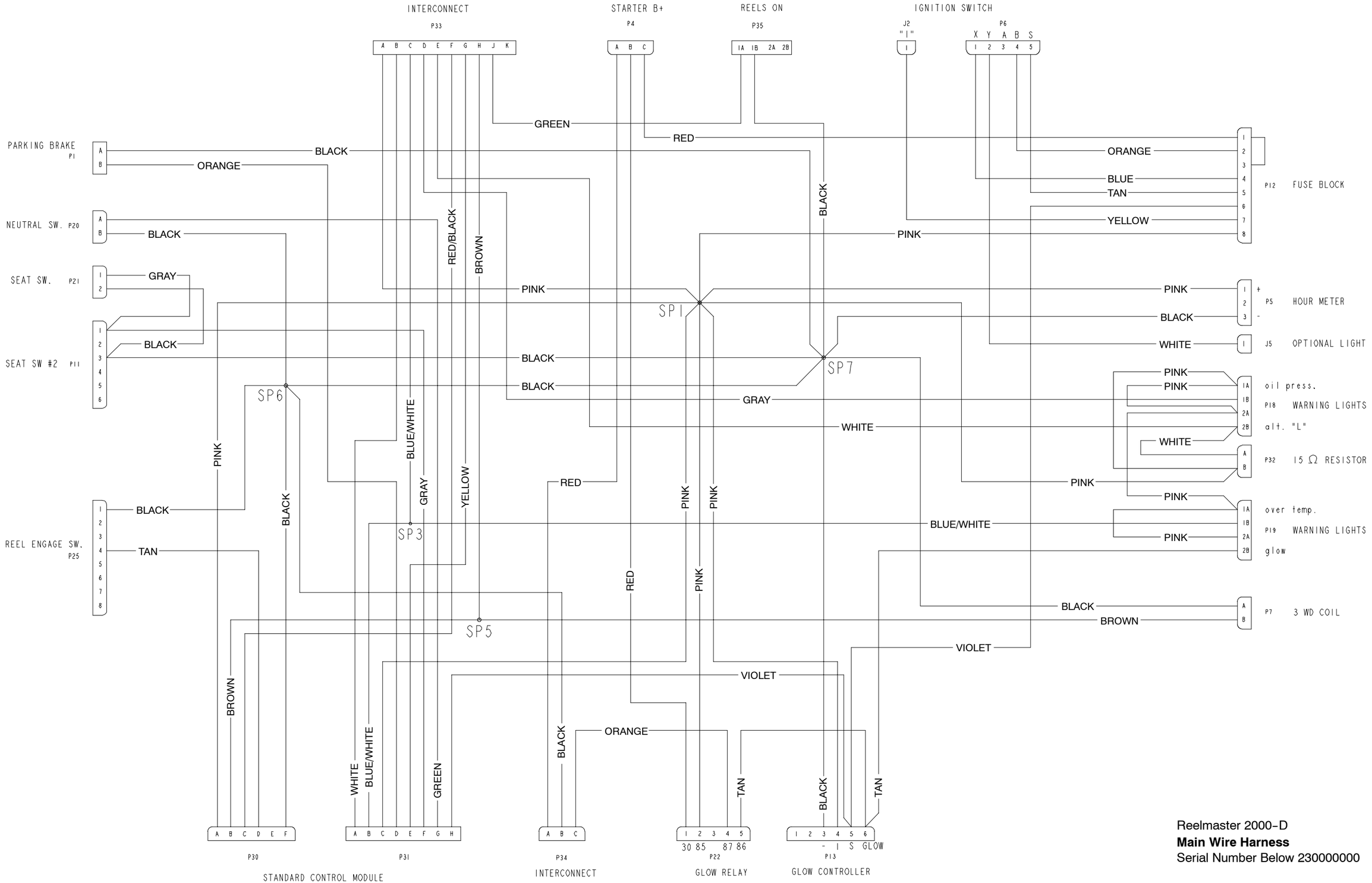
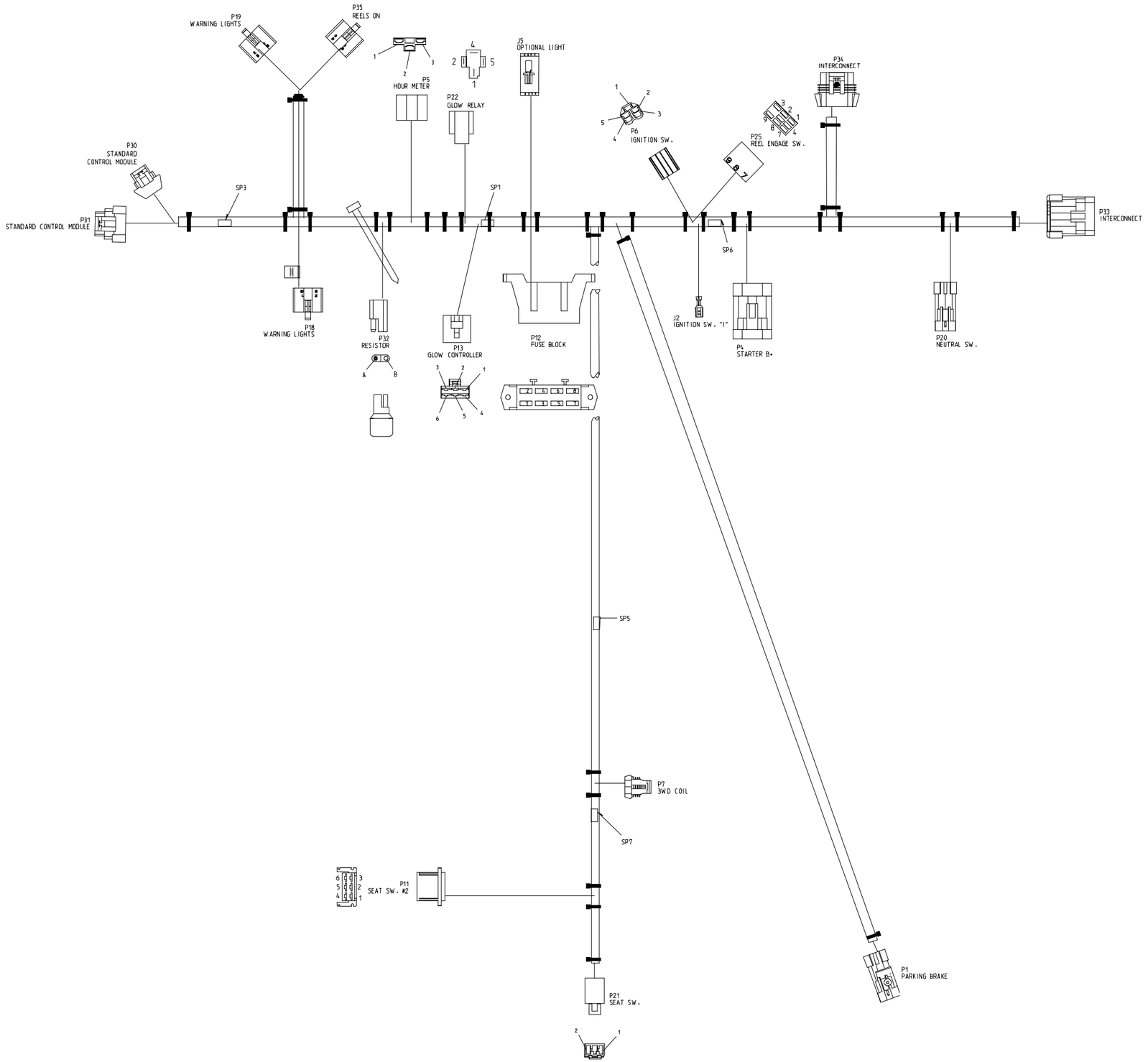
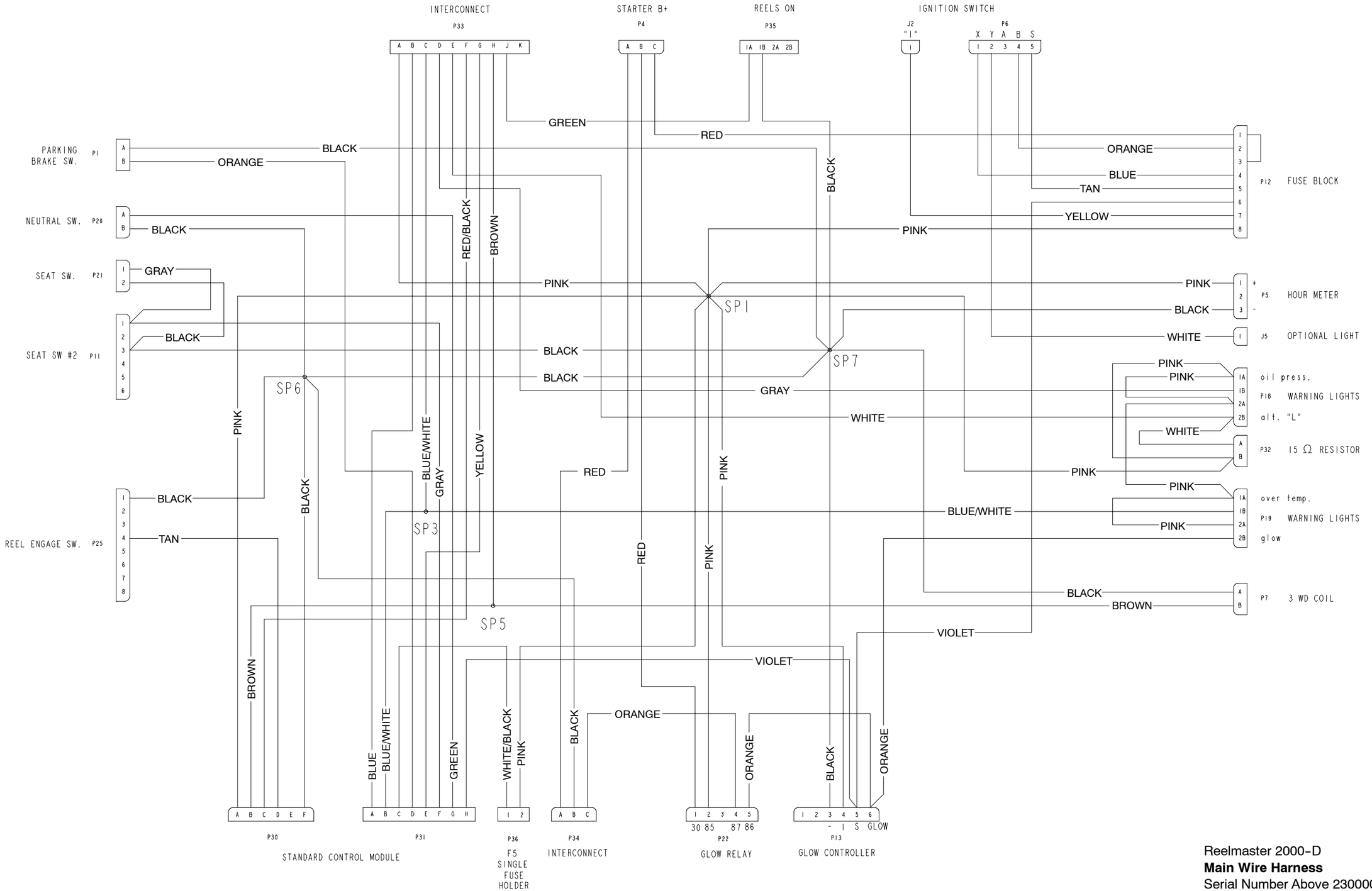


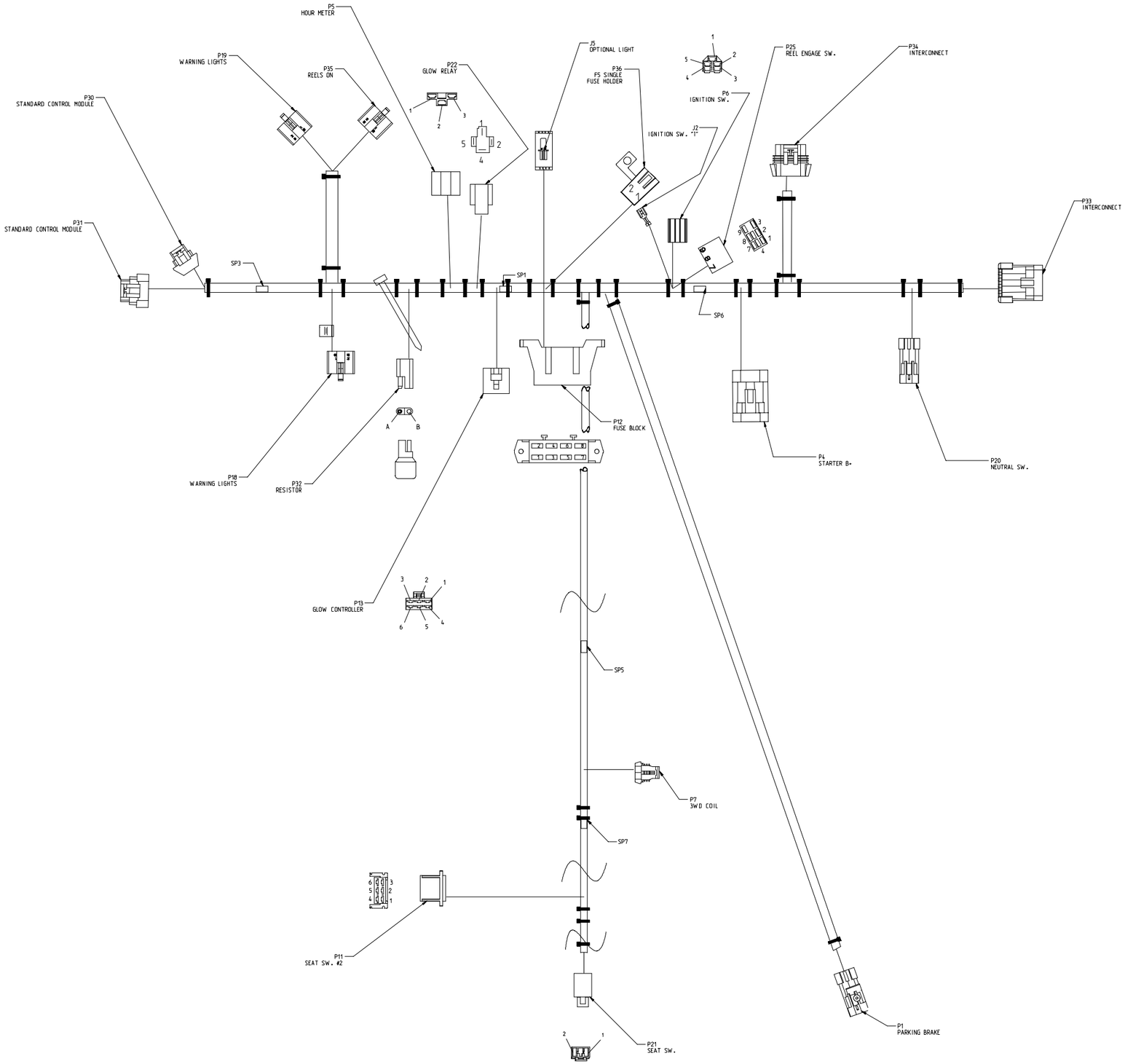
Reelmaster 2000-D
Main Wire Harness
Serial Number Below 230000000



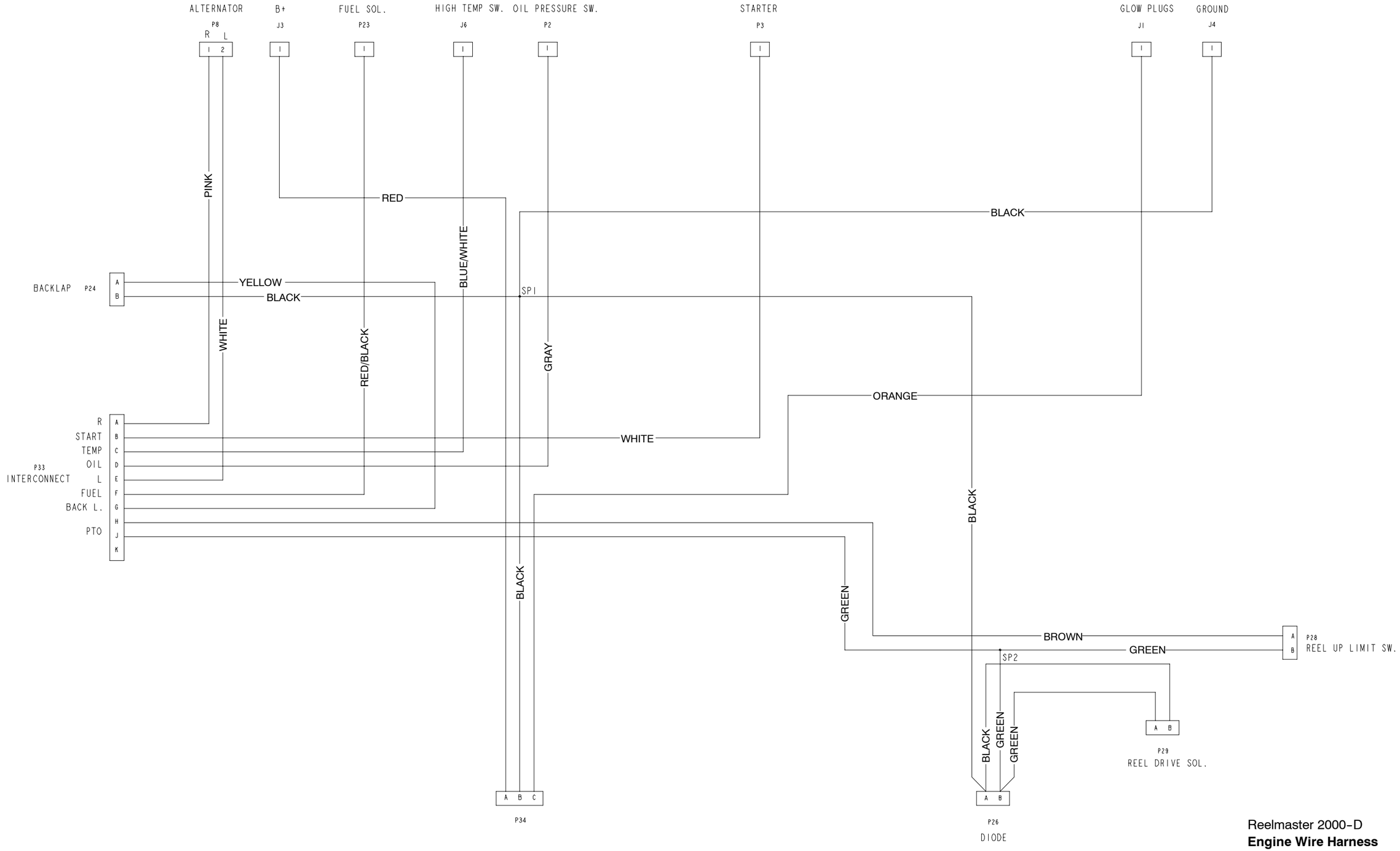
Reelmaster 2000-D
Main Wire Harness
Serial Number Below 230000000



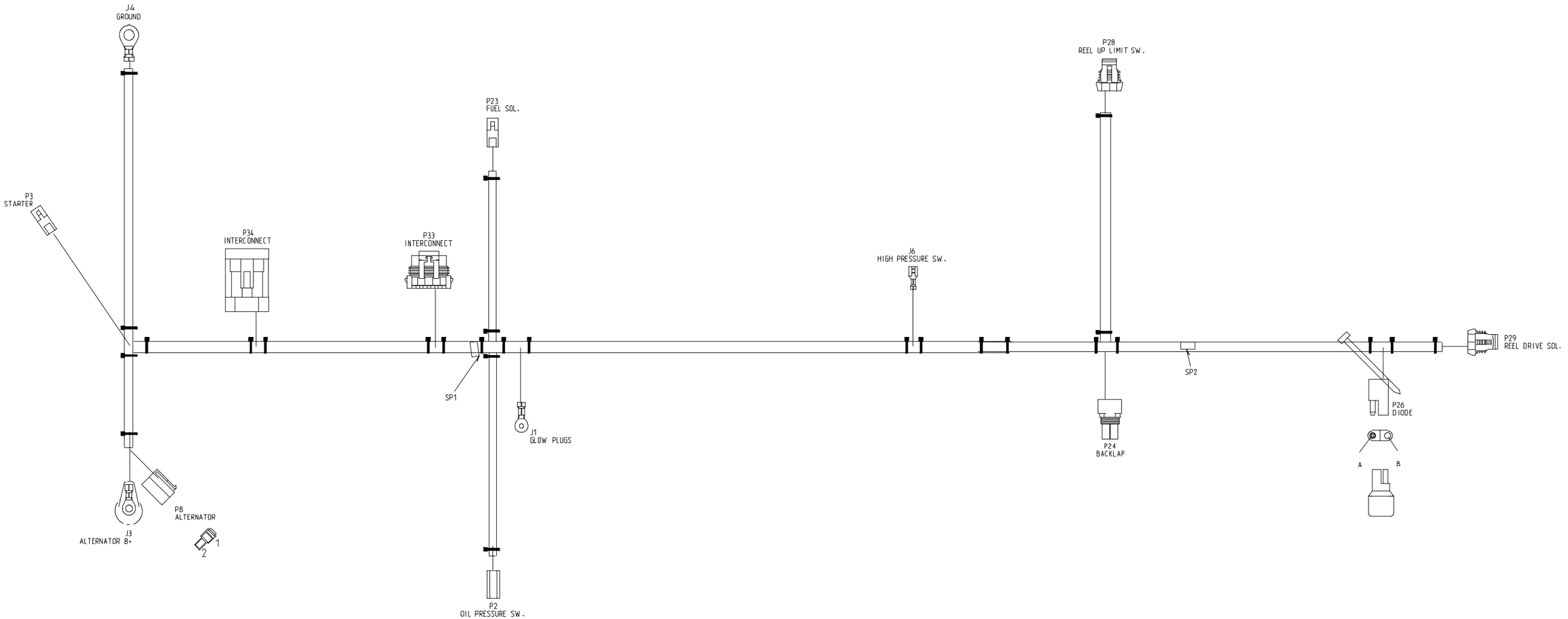
Reelmaster 2000-D
Main Wire Harness
Serial Number Above 230000000



Reelmaster 2000-D
Main Wire Harness
Serial Number Above 230000000



Reelmaster 2000-D
Engine Wire Harness


J4
GROUND
P3
STARTER
P34
INTERCONNECT
P33
INTERCONNECT
P23
FUEL SOL.
J6
HIGH PRESSURE SW.
P28
REEL UP LIMIT SW.
P29
REEL DRIVE SOL.
SP1
SP2
J1
GLOW PLUGS
P24
BACKLAP
P26
DIODE
A
B
P8
ALTERNATOR
J3
ALTERNATOR B+
2
1
P2
OIL PRESSURE SW.

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